

Appendix A
Sampling and Analysis Plan

SAP Worksheet #1—Title and Approval Page

Final

**SAMPLING AND ANALYSIS PLAN
(Field Sampling Plan and Quality Assurance Project Plan)**

June 2012

**Supplemental Investigation
Former Building 88 and Traffic Island Areas
Installation Restoration Site 28
Former Naval Air Station Moffett Field
Moffett Field, California**

Prepared for:

U.S. Department of the Navy
Base Realignment and Closure
Program Management Office West Naval Facilities Engineering Command
1455 Frazee Rd, Suite 900
San Diego, California 92108

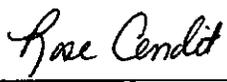
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Prepared under:

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Review Signature:

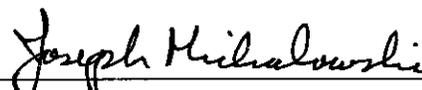


Rose Condit/Program Chemist Date

June 12, 2012

Date

Approval Signature:



Joseph Michalowski/NAVFAC SW Acting QA Officer Date

June 20, 2012

Date

EXECUTIVE SUMMARY

This Sampling and Analysis Plan has been prepared by Shaw Environmental & Infrastructure, Inc. to perform a supplemental investigation of chlorinated ethenes (CE) in the A and B Aquifers in two specific areas at Installation Restoration (IR) Site 28, the Former Building 88 Area and Traffic Island Area, former Naval Air Station Moffett Field, Moffett Field, California (Figure A1).

The A-Aquifer at IR Site 28 is impacted by volatile organic compounds (VOCs), primarily CEs, which resulted from on-site Navy sources and on-flow of contamination from upgradient VOC sources. The U.S. Environmental Protection Agency (EPA) is currently preparing the Supplemental Sitewide Groundwater Feasibility Study for the MEW Superfund Study Area to evaluate the ability of several remedial alternatives to reduce concentrations of CEs and to remediate the regional plume. All of the alternatives evaluated in the feasibility study include source treatment. The U.S. Department of the Navy (Navy) has identified two areas at IR Site 28 as “source areas,” Former Building 88 and the Traffic Island Areas; however neither area is adequately defined. The areas of IR Site 28 that appear to be a continuing source of CEs to groundwater are the area encompassing former Building 88 and the area encompassing the traffic island at the intersection of Wescoat Road and Cummins Avenue. Building 88 served as a dry cleaning and laundry facility from approximately 1945 until its closure in 1987. The Navy conducted a removal action in 1994, which included the demolition of the building and the removal of associated tanks and sumps. The Navy began groundwater source control in 1994. A continuing source of tetrachloroethene contamination to groundwater was identified beneath the footprint of former Building 88 and beneath the traffic island located at the intersection of Wescoat Road and Cummins Avenue. It is likely that contaminants detected at the Former Building 88 Area migrated through the sanitary sewer and exited via a break in the utility line near the Traffic Island Area. Additionally, since 2005, results of soil and groundwater sampling conducted in the Traffic Island Area have suggested that the B-Aquifer, which underlies the A-Aquifer, may also be impacted by CEs with increasing concentrations.

The purpose of this supplemental investigation is to augment the characterization of IR Site 28 CEs contamination at the Former Building 88 and Traffic Island Areas. The primary objective of the investigation is to refine the understanding of the soil stratigraphy and further characterize the lateral and vertical extent of tetrachloroethene and its daughter products (trichloroethene, cis 1,2-dichloroethene, and vinyl chloride) in the saturated zone at the Former Building 88 and Traffic Island source areas.

This supplemental investigation will be implemented in two-phases. Phase I will involve a preliminary screening survey to further assess the distribution of CEs and soil lithology in the

investigation areas. The data generated by Phase I, along with existing data, will be used to identify where new monitoring wells should be installed during Phase II.

The Phase I screening survey will use the Navy's Site Characterization Analysis Penetrometer System and associated membrane interface probe and direct sample ion-trap mass spectrometer equipment to generate vertical profiles of VOC concentrations in the subsurface at up to 52 locations. Additionally, built in cone penetrometer test equipment will concurrently profile the associated soil strata at each location.

Phase II will include installing up to 12 new monitoring wells and collecting groundwater samples from these wells. The location of each new well and screen interval will be determined during the evaluation of the Phase I results and existing data. The new wells will be installed and sampled after the proposed well locations and screen intervals are presented to the regulatory agencies. The new wells will be sampled during two separate events to establish concentrations of CEs in groundwater at these locations. The samples will be analyzed for VOCs and dissolved gases.

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- Attachment 1 Meeting Minutes PQO and Work Plan Development Meeting–IR Site 28
- Attachment 2 Laboratory SOPs
- Attachment 3 Laboratory Information (DoD ELAP Accreditation Certificate and In-House Control Limits)

List of Acronyms

%	percent
<	less than
>	greater than
±	plus or minus
≥	greater than or equal to
°C	degree Celsius
µg/L	microgram per liter
µV	microvolt
bgs	below ground surface
BRAC PMO West	Base Realignment and Closure Program Management Office West
C&T	Curtis and Tompkins Laboratory
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CE	chlorinated ethene
CPT	cone penetrometer test
CSM	Conceptual Site Model
DCE	dichloroethene
DNAPL	dense non-aqueous phase liquid
DO	dissolved oxygen
DoD	U.S. Department of Defense
DoD QSM	<i>Quality System Manual for Environmental Laboratories, Version 4.2</i>
DQA	Data Quality Assessment
DQO	Data Quality Objective
DSITMS	direct sample ion-trap mass spectrometer
DVG	The Data Validation Group
ECD	electron capture detector
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ERP	Environmental Restoration Program
ESD	explanation of significant differences
ft/day	foot (feet) per day
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
H&S	health and safety
HSO	Health and Safety Officer
ICAL	initial calibration
IR	Installation Restoration
LCD	laboratory control duplicate
LCS	laboratory control sample
LOQ	limit of quantitation
MEW	Middlefield Ellis Whisman

List of Acronyms (continued)

MCL	maximum contaminant level
MIP	membrane interface probe
mL	milliliter
Moffett	Former Naval Air Station Moffett Field
MS/MSD	matrix spike/matrix spike duplicate
NAS	Naval Air Station
NASA	National Aeronautics and Space Administration
NAVFAC SW	Naval Facilities Engineering Command Southwest
Navy	U.S. Department of the Navy
NIRIS	Naval Installation Restoration Information Solutions
ORP	oxygen reduction potential
PCE	tetrachloroethene
PID	photoionization detector
PM	Project Manager
POC	point of contact
PRC	PRC Environmental Management, Inc.
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
ROD	<i>Record of Decision for the Fairchild, Intel, and Raytheon Sites, Middlefield/Ellis/Whisman (MEW) Study Area, Mountain View, California</i>
RPD	relative percent difference
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SCAPS	Site Characterization Analysis Penetrometer System
Shaw	Shaw Environmental, Inc.
Shaw E&I	Shaw Environmental & Infrastructure, Inc.
SOP	standard operating procedure
TCE	trichloroethene
TtECI	Tetra Tech EC, Inc.
TtFWI	Tetra Tech FW, Inc.
UFP	Uniform Federal Policy
VC	vinyl chloride
VOC	volatile organic compound
Water Board	Regional Water Quality Control Board, San Francisco Bay Region
WATS	West Side Aquifers Treatment System
WS	Worksheet

SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Installation Restoration (IR) Site 28
Contractor Name: Shaw Environmental & Infrastructure, Inc. (Shaw E&I)
Contract Number: N62473-10-D-4009
Contract Title: Environmental Services
Work Assignment Number: Task Order 0046

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (U.S. Environmental Protection Agency [EPA], 2005) and *EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (EPA, 2001a). With additional guidance from:
 - *Quality System Manual for Environmental Laboratories, Version 4.2* (DoD QSM; U.S. Department of Defense [DoD], 2010)
 - *Guidance on Systematic Planning Using the Data Quality Objectives Process, EPA QA/G-4* (EPA, 2006)
 - *Environmental Work Instruction 3EN2.1 – Chemical Data Validation* (Naval Facilities Engineering Command Southwest [NAVFAC SW], 2001)
 - *Environmental Work Instruction EVR.2 – Review, Approval, Revision, and Amendment of Sampling and Analysis Plans (SAPs)* (NAVFAC SW, 2011)
 - *Environmental Work Instruction EVR.4 – Implementing and Maintaining the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record and Compendium at NAVFAC Southwest* (NAVFAC SW, 2007)
 - *Environmental Work Instruction EVR.6 – Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW, 2005)
2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).
3. This is a project-specific SAP.
4. List dates of scoping sessions that were held:

October 25, 2011 Supplemental Investigation Team Meeting—IR Site 28 (Attachment 1)

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
<i>Final Addendum 01 to the Final Sampling and Analysis Plan for In Situ Anaerobic Biotic/Abiotic Treatability Study Installation Restoration Site 28, Former Naval Air Station Moffett Field, Moffett Field, California (Shaw E&I)</i>	January 2012
<i>Final Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) In Situ Anaerobic Biotic/Abiotic Treatability Study IR Site 28, Former Naval Air Station Moffett Field, Moffett Field, California (Shaw E&I, 2010) (Appendix A)</i>	February 26, 2010

6. List organizational partners (stakeholders) and connection with lead organization:
Example for project-specific SAPs:

Oversight by the EPA, Region 9 (Primary Regulatory Agency)
Oversight by the Regional Water Quality Control Board, San Francisco Bay Region (Water Board)
Active property occupant—National Aeronautics and Space Administration (NASA)

7. Lead organization:

U.S. Department of the Navy (Navy)

8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

Worksheet (WS) #8—No special training required
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UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
<i>Documentation</i>		
1	Title and Approval Page	
2	Table of Contents; SAP Identifying Information	
3	Distribution List	
4	Project Personnel Sign-Off Sheet	
<i>Project Organization</i>		
5	Project Organizational Chart	
6	Communication Pathways	
7	Personnel Responsibilities and Qualifications Table	
8	Special Personnel Training Requirements Table	No special training required
<i>Project Planning/ Problem Definition</i>		
9	Project Planning Session Documentation (including Data Needs tables); Project Scoping Session Participants Sheet	
10	Problem Definition, Site History, and Background. Site Maps (historical and present)	
11	Site-Specific Project Quality Objectives	
12	Measurement Performance Criteria Table	
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	
14	Summary of Project Tasks	
15	Reference Limits and Evaluation Table	
16	Project Schedule/Timeline Table	
B. Measurement Data Acquisition		
<i>Sampling Tasks</i>		
17	Sampling Design and Rationale	
18	Sampling Locations and Methods/ Standard Operating Procedure (SOP) Requirements Table Sample Location Map(s)	
19	Analytical Methods/SOP Requirements Table	
20	Field Quality Control (QC) Sample Summary Table	
21	Project Sampling SOP References Table Sampling SOPs	
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	
<i>Analytical Tasks</i>		
23	Analytical SOPs Analytical SOP References Table	
24	Analytical Instrument Calibration Table	

UFP-QAPP Worksheet #	Required Information	Crosswalk to Related Information
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	
<i>Sample Collection</i>		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain of Custody Form	
<i>QC Samples</i>		
28	QC Samples Table; Screening/Confirmatory Analysis Decision Tree	
<i>Data Management Tasks</i>		
29	Project Documents and Records Table	
30	Analytical Services Table Analytical and Data Management SOPs	
C. Assessment Oversight		
31	Planned Project Assessments Table Audit Checklists	
32	Assessment Findings and Corrective Action Responses Table	
33	Quality Assurance (QA) Management Reports Table	
D. Data Review		
34	Verification (Step I) Process Table	
35	Validation (Steps IIa and IIb) Process Table	
36	Validation (Steps IIa and IIb) Summary Table	
37	Usability Assessment	

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Valerie Harris	Remedial Project Manager (RPM)	Base Realignment and Closure Program Management Office West (BRAC PMO West) NAVFAC SW	619.532.0981	valerie.j.harris@navy.mil BRAC PMO West, NAVFAC SW 1455 Frazee Road, Suite 900 San Diego, California 92108
Gary Munekawa	Resident Officer in Charge of Construction	NAVFAC SW	650.603.9834	gary.munekawa@navy.mil NAVFAC SW P.O. Box 68, Bldg. 107 Moffett Field, California 94035
David Smith	Resident Officer in Charge of Construction	NAVFAC SW	650.603.9836	david.r.smith2@navy.mil NAVFAC SW P.O. Box 68, Bldg. 107 Moffett Field, California 94035
Joseph Michalowski	NAVFAC SW Acting Quality Assurance Officer (QAO)	NAVFAC SW	619.532.4125	joseph.michalowski@navy.mil NAVFAC SW Building 127, 1220 Pacific Hwy, San Diego, California 92132-5190
Penny Wilson Reddy	RPM	EPA, Region 9	415.972.3108	reddy.penny@epamail.epa.gov EPA, Region 9 75 Hawthorne Street San Francisco, California 94105
Elizabeth Wells	RPM	Water Board	510.622.2440	ewells@waterboards.ca.gov Regional Water Quality Control Board – San Francisco Bay Region 1515 Clay St., Ste 1400 Oakland, California 94612
Rose Condit	Program Chemist	Shaw E&I	925.288.2151	rose.condit@shawgrp.com Shaw E&I 4005 Port Chicago Hwy Concord, California 94520

SAP Worksheet #3—Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Neil Hey	Project Manager (PM)	Shaw E&I	925.288.2141	neil.hey@shawgrp.com Shaw E&I 4005 Port Chicago Hwy Concord, California 94520
Tom Barry	Technical Lead	Shaw E&I	415.512.2207	tom.barry@shawgrp.com Shaw E&I 185 Berry Street, Suite 2200 San Francisco, California 94107
Jim Teo	Site Supervisor	Shaw E&I	415.512.2428	james.teo@shawgrp.com Shaw E&I 185 Berry Street, RM 2200 San Francisco, California 94107
Junn Masongsong	Project Chemist	Shaw E&I	925.288.2314	junn.masongsong@shawgrp.com Shaw E&I 4005 Port Chicago Hwy Concord, California 94520
Mark Vennemeyer	Project QC Manager Safety and Health Officer	Shaw E&I	925.288.2383	mark.vennemeyer@shawgrp.com Shaw E&I 4005 Port Chicago Hwy Concord, California 94520
Mike Dahlquist	Laboratory PM	Curtis and Tompkins Laboratory (C&T)	510.486.0900	mike.dahlquist@ctberk.com C&T 2323 Fifth Street Berkeley, California 94710
Tim Shields	SCAPs Manager	Brady	858.496.0500	tshields@rbrady.net 3710 Ruffin Road San Diego, CA 92123

SAP Worksheet #3—Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
William Davis	SCAPs Chemist	Triad Environmental Solutions, Inc	404.378.3326	wmdavis@triad-env.com 220 Kathryn Avenue Decatur, Georgia 30030
Robbin Robl	Laboratory PM	Microseeps	412.826.5245	rrobl@microseeps.com 220 William Pitt Way Pittsburgh, PA 15238
Sandra Oblease	Data Validation PM	The Data Validation Group	949.709.7442	thedvgroup@cox.net The Data Validation Group 43 Sea Country Lane Rancho Santa Margarita, CA 92688

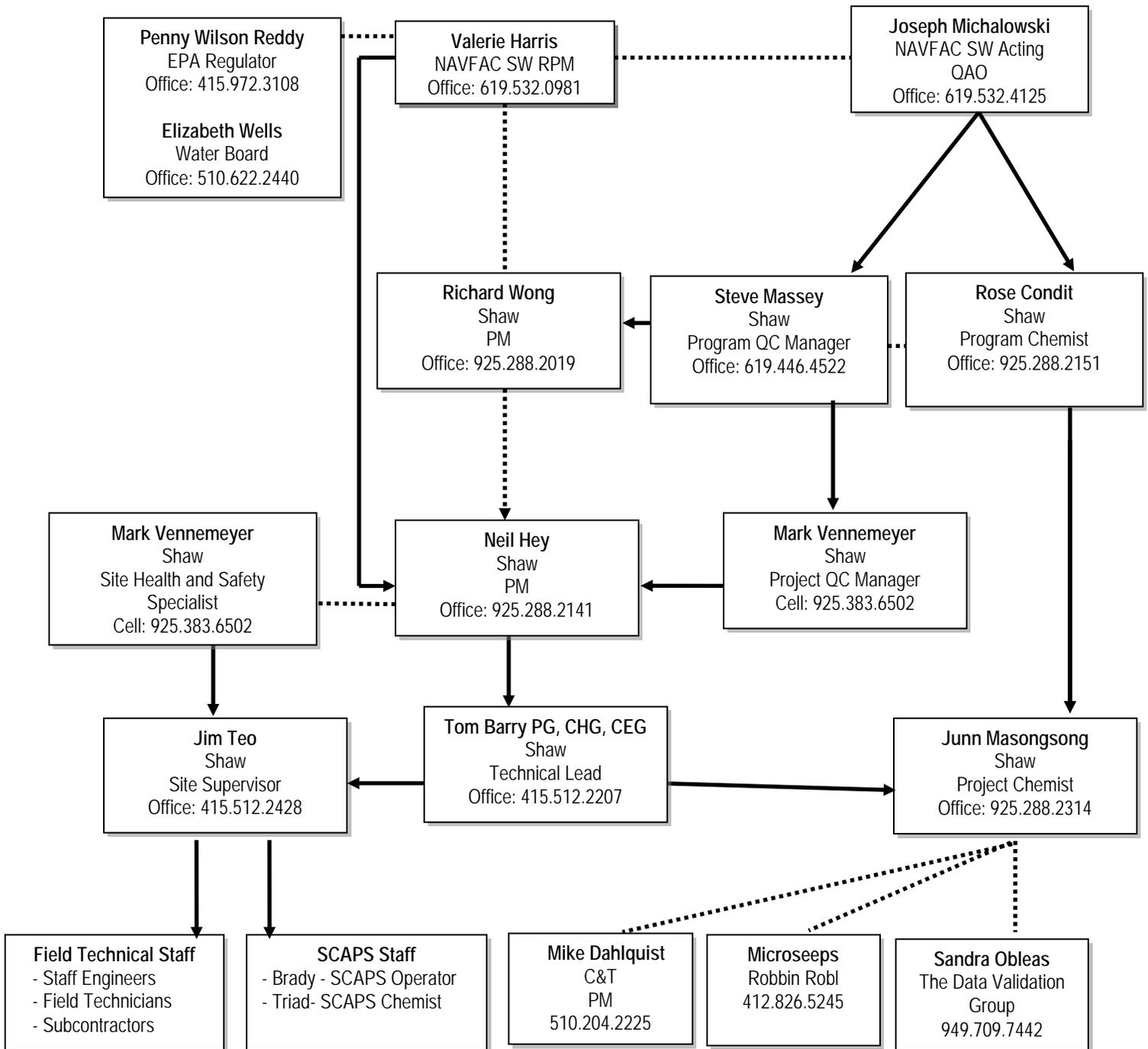
SAP Worksheet #4—Project Personnel Sign-Off Sheet

The Project Personnel Sign-Off Sheet will be used to document all key project personnel performing site work have read the applicable sections of the SAP and will perform the sampling and analysis tasks as described. Signed WS #4 will be stored in the on-site project files, and then will be transferred to Shaw E&I home office file storage at completion of field work.

Name	Organization/Title/Role	Signature/Email Receipt	SAP Section Reviewed	Date SAP Read
Neil Hey	Shaw E&I, PM			
Tom Barry	Shaw E&I, Technical Lead			
Jim Teo	Shaw E&I, Site Supervisor			
Junn Masongsong	Shaw E&I, Project Chemist			
Mark Vennemeyer	Shaw E&I, Project QC Manager			
Mike Dahlquist	C&T, PM			
Sandra Oblease	The Data Validation Group, PM			
Robbin Robl	Microseeps Laboratory PM			
	Brady, SCAPS Operator			
	Triad Chemist			

SAP Worksheet #5—Project Organization Chart

All lines of responsibility (solid lines) and lines of communication (dotted lines) are provided.



SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or email	Procedure
Point of Contact (POC) with Regulators	NAVFAC SW RPM	Valerie Harris	619.532.0981	The NAVFAC SW RPM will be the primary POC with regulators. All materials and information about the project will be forwarded to regulator through the NAVFAC SW RPM
POC with NAVFAC SW RPM	Shaw E&I PM	Neil Hey	925.288.2141	All materials and information about the project will be forwarded to RPM by PM
SAP Changes in the Field	Project or Program Chemist	Junn Masongsong or Rose Condit	925.288.2314 925.288.2151	The Project Chemist is responsible for documenting field changes related to sampling and for informing or seeking approval from the Program Chemist or Navy QAO. The Project Chemist or Program Chemist is also responsible for generating SAP amendments as necessary for approval by the Navy QAO. The Project Chemist oversees the documentation, notification and corrective actions associated with project management issues in writing. Due to the potential impact field changes and SAP amendments may have on the project, the Project Chemist is to be notified of such issues within 24 hours.
Sampling Quality Issues	Project or Program QC Manager Project or Program Chemist	Mark Vennemeyer or Steve Massey Junn Masongsong or Rose Condit	925.288.2383/ 619.446.4522 925.288.22314/ 925.288.2151	In general, the Project Chemist is the POC for sampling and chemistry issues and the Project QC Manager is the POC for other quality issues. If quality issues are not resolved at the project level (in consultation with the PM, site supervisor, technical lead, etc.), then the issue will be elevated to the Program Chemist or Program QC Manager (Steve Massey). The program Chemist or designee will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project QC Manager or Project Chemist oversees the documentation, notification and corrective actions associated with the QC issue in writing.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or email	Procedure
Sample collection issues	Project or Program Chemist	Junn Masongsong or Rose Condit	925.288.2055 925.288.2151	The Project Chemist is the POC for sampling and chemistry issues. If sampling issues are not resolved at the project level (in consultation with the PM, Site Supervisor, Technical Lead, Geologist, etc.), then the issue will be elevated to the Program Chemist or Program QAO. The Program Chemist or Program QAO will seek additional guidance or approval from the Navy QAO, if necessary. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the QA issue in writing. Due to the potential impact sampling issues may have on the project; the Project Chemist is to be notified of sampling issues within 24 hours.
Notification of Nonusable Analytical Data	Shaw E&I Program Chemist	Rose Condit	925.288.2151	If significant problems are identified by the laboratory or the project team that impact the usability of the data (i.e., the data is rejected or the data quality objectives [DQO] are not met), the Program Chemist will notify the NAVFAC SW RPM and the NAVFAC SW QAO within 24 hours or the next business day
Laboratory reporting or data quality issues	Shaw E&I Project Chemist Laboratory PM Data Validation PM	Junn Masongsong Mike Dahlquist Linda Rauto	925.288.2314 510.204.2225 760.634.0437	The Project Chemist is the POC for laboratory issues. The Project Data Manager is the POC for electronic data deliverables (EDD). If laboratory issues are not resolved with the Project Chemist or Data Manager, then the issues will be elevated to the Program Chemist. Upon resolution, the Project Chemist oversees the documentation, notification, and corrective actions associated with the laboratory issues in writing.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Telephone Number and/or email	Procedure
Field activity issues	Site Supervisor	Jim Teo	415.512.2428	The Site Supervisor is the POC for all project site activities such as scheduling, staffing, subcontractors, field work, etc. The Site Supervisor, in consultation with the PM and NAVFAC SW RPM, if necessary, will resolve all project site issues. Upon resolution, the Site Supervisor oversees the documentation, notification, and corrective actions associated with site issues in writing. The Site Supervisor is to be notified of site issues within 72 hours.
Health and safety (H&S) issues	Health and Safety Officer (HSO)	Mark Vennemeyer	925.383.6502	The Project HSO is the POC for H&S issues. If H&S issues are not resolved at the project level (in consultation with the PM, Site Supervisor, Technical Lead, etc.), then the issue will be elevated to the Program HSO. The Program HSO or designee will seek additional guidance or approval from the Navy HSO, if necessary. Upon resolution, the Project HSO oversees the documentation, notification, and corrective actions associated with the issue in writing. Due to the potential seriousness of H&S issues, the HSO is to be notified of H&S issues immediately.

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibility
Valerie Harris	NAVFAC SW RPM	Navy	Manages governmental oversight of the project Manages project funding and scope Coordinates project documents review Primary contact and liaison with regulatory agencies Responsible for technical oversight of the project
Joseph Michalowski	Acting Navy QAO	Navy	Provides governmental oversight of the Shaw E&I QA Program Provides quality-related directives through Contracting Officer's Technical Representative Reviews and approves the SAP prior to regulatory review and field implementation Provides technical and administrative oversight of Shaw E&I surveillance audit activities Acts as point-of-contact on all matters concerning QA and the client's Laboratory QA Program Authorized to suspend project execution if QA requirements are not adequately followed
Neil Hey	PM	Shaw E&I	Manages oversight of the project for Shaw E&I POC for communication with the NAVFAC SW RPM and Navy Contracts Ensures that all requirements of project contract are attained in a manner consistent with Project Plans Oversees planning, execution, and conclusion of all project activities Manages project budgets and schedules
Rose Condit	Program Chemist	Shaw E&I	Reviews and approves the SAP Guides the selection of subcontract analytical laboratories Conducts field and laboratory audits Serves as a POC for the Navy QAO Develops corrective action as required Serves as a technical advisor to the project
Tom Barry	Technical Lead	Shaw E&I	Develops Work Plans to address project scope of work Serves as a technical lead to the project Reports to PM

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
Junn Masongsong	Project Chemist	Shaw E&I	Develops the project DQOs and prepares the SAP Selects qualified subcontract laboratories Implements chemical data QC procedures and audits field performance Reviews laboratory data prior to use Performs validation of laboratory data Prepares the appropriate sections of the report summarizing the project sampling activities
Mark Vennemeyer	Project QC Manager	Shaw E&I	Develops the project QC objectives and prepares the QC Plan Administers the QC Plan Manages QC documentation and QC deliverables Lists definable features of work Conducts inspections (preparatory, initial, follow-up, completions)
Mark Vennemeyer	HSO	Shaw E&I	Develops and administers the Site Safety and Health Plan Manages personnel and environmental monitoring Coordinates preparation of Job Safety Analyses Selects appropriate personal protective equipment Reviews essential H&S requirements with on-site personnel Facilitates daily safety meetings
Junn Masongsong	Field Technician	Shaw E&I	Performs all sampling in accordance with approved SAP Ensures that field QC samples are collected as specified in the SAP Completes field documentation Coordinates laboratory and field sampling activities Implements field corrective actions as required
Mike Dahlquist	Laboratory PM	C&T	Oversees proper analysis and reporting of project samples. Manages communication between laboratory and Shaw E&I Project Chemist Ensure proper QA/QC procedures are followed during laboratory analysis
Robbin Robl	Laboratory PM	Microseeps	Oversees proper analysis and reporting of project samples. Manages communication between laboratory and Shaw E&I Project Chemist Ensure proper QA/QC procedures are followed during laboratory analysis

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibility
Sandra Oblease	Data Validation PM	The Data Validation Group	Performs data validation according to applicable methods and the SAP Reviews laboratory reports for compliance with applicable methods and the SAP Applies validation qualifiers to analytical data Prepares data validation report

SAP Worksheet #8—Special Personnel Training Requirements Table

All field personnel will be required to have completed the Occupational Safety and Health Administration 40-hour Hazardous Waste Operations and Emergency Response Standard Protection training, continued 8-hour Hazardous Waste Operations and Emergency Response and submit to annual medical surveillance, as required by Occupational Safety and Health Administration. The Shaw E&I Site H&S Manager will be responsible for ensuring that training and/or certification is met and that qualified personnel are performing the work.

No specialized training required for this project.

SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: IR Site 28- Supplemental Investigation	Site Name: IR Site 28
Projected Date(s) of Sampling: February 2012 through September 2012	Site Location: Former Naval Air Station Moffett Field, Moffett Field, California
Project Manager: Neil Hey	
Date of Session: Tuesday, October 25, 2011	
Scoping Session Purpose: Supplemental Investigation Meeting–IR Site 28	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
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Comments/Decisions:

See Attachment 1

Action Items:

See Attachment 1

Consensus Decisions:

See Attachment 1

SAP Worksheet #10—Problem Definition

The planning team consists of the representatives of the Navy and Shaw E&I with primary oversight by EPA, Region 9 with input from the Water Board. The Navy is the lead federal agency for the direction of the site activities and the prime decision-maker.

The A-Aquifer at IR Site 28 is impacted by volatile organic compounds (VOCs), primarily chlorinated ethenes (CEs), which resulted from on-site Navy sources and on-flow of contamination from upgradient VOC sources at the Middlefield Ellis Whisman (MEW) Superfund Site. Though a remedy is in place (pump and treat), the EPA is currently preparing the Supplemental Sitewide Groundwater Feasibility Study for the MEW Superfund Study Area to evaluate the ability of several remedial alternatives to reduce concentrations of CEs and remediate the regional plume. All of the alternatives that will be evaluated in the EPA's feasibility study include source treatment. Although prior investigations have provided valuable insight into the nature and extent of the Navy's source areas, several key data gaps remain in the Conceptual Site Model (CSM) for the Former Building 88 and Traffic Island Areas that need to be addressed before further remediation can be designed. Specifically, additional characterization is needed to:

- Further delineate the distribution of tetrachloroethene (PCE) and its daughter products (trichloroethene [TCE], cis 1,2-dichloroethene [DCE], and vinyl chloride [VC]) in the A-Aquifer within and around the Former Building 88 and Traffic Island source areas
- Confirm the depth to and lateral continuity of the A/B-Aquitard in the Traffic Island Area
- Verify the depth to the top of the B2-Aquifer in the Traffic Island Area
- Confirm whether existing well W88-1 is screened in the B2-Aquifer
- Confirm whether the B-Aquifer beneath the Traffic Island Area is impacted with CEs above the *Record of Decision for the Fairchild, Intel, and Raytheon Sites, Middlefield/Ellis/Whisman (MEW) Study Area, Mountain View, California* (ROD; EPA, 1989) cleanup standards and maximum contaminant levels (MCLs)

These data will reduce uncertainties and strengthen the CSM for these two source areas. Additionally, since 2005, results of soil and groundwater sampling conducted in the Traffic Island Area have suggested that the B-Aquifer, which underlies the A-Aquifer, may also be impacted by CEs with increasing concentrations in groundwater.

The purpose of this supplemental investigation is to augment the characterization of IR Site 28 CEs contamination at the Former Building 88 and Traffic Island Areas. The primary objective of the investigation is to refine the understanding of the soil stratigraphy and to further characterize

the lateral and vertical extent of PCE and its daughter products (TCE, cis 1,2-DCE, and VC) in the saturated zone at the Former Building 88 and Traffic Island Areas.

10.1 CONCEPTUAL SITE MODEL

The following section presents summaries of site history and background, previous investigations, and information used to develop the supplemental investigation at IR Site 28.

10.1.1 Site Description

Former Naval Air Station Moffett Field (Moffett) is located 35 miles south of San Francisco at the northern end of the Santa Clara Valley Basin, approximately 1 mile south of San Francisco Bay (Figure A1). Prior to development in the early 1930s, the surrounding area was used for agriculture and portions of Moffett consisted of tidal mudflats that have been filled in. Moffett was originally commissioned as Naval Air Station (NAS) Sunnyvale in 1933 to support the West Coast lighter-than-air dirigibles, and was transferred to the U.S. Army Air Corps in 1935 for training purposes. In 1939, a permit was granted to Ames Aeronautical Laboratory to use a portion of the base. NAS Sunnyvale was returned to Navy control in 1942 and was renamed NAS Moffett Field. In 1994, NAS Moffett Field was closed under the DoD Base Realignment and Closure program. The operational area of NAS Moffett Field was transferred to NASA, and the military housing portions were transferred to the U.S. Air Force on July 1, 1994 (SES-TECH, 2009). The housing areas were subsequently transferred to the U.S. Army in 2000. The facility is presently referred to as the NASA Ames Research Center and Moffett Federal Airfield, and includes airfield operations, NASA research facilities, and a golf course operated by NASA. Moffett is on the National Priorities List, and site cleanup is conducted in accordance with the CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986. Twenty-nine sites have been identified as IR Program sites at Moffett.

IR Site 28 is the aquifers below the area generally defined by the outline shown on Figure A1. Current primary uses of this area include airfield operations, administrative offices, and various storage buildings. The A-Aquifer at IR Site 28 is impacted by VOCs, primarily CEs, which resulted from on-site Navy sources and on-flow of contamination from upgradient VOC sources originating primarily from the MEW Superfund Site. The requirements for the remediation of impacted groundwater at IR Site 28 are set forth in the ROD (EPA, 1989). The Navy adopted the ROD in 1993, which is documented in the *Federal Facilities Agreement Amendment of December 17, 1993, NAS Moffett Field, California* (Navy, 1993). The selected remedy for groundwater at IR Site 28 is extraction and ex situ treatment to restore groundwater to the cleanup standards specified in the ROD. The EPA's explanation of significant differences (ESDs) for the ROD were submitted in September 1990 and April 1996. The September 1990 ESD clarified that the cleanup goals constituted final cleanup standards and that the remedial activity must meet the final cleanup standard of 5 micrograms per liter ($\mu\text{g/L}$) for TCE in the upper and lower portions of the A-Aquifer (EPA, 1990). TCE was selected as an indicator

chemical assuming that by remediating TCE, the other chemicals of concern would be remediated simultaneously. The April 1996 ESD clarified that the groundwater remedy includes the use of liquid-phase granular activated carbon as a treatment option for extracted groundwater (EPA, 1996).

Previous investigations at Moffett determined that historical dry cleaning activities conducted at former Building 88 were the source of PCE released to the subsurface at IR Site 28 (Tetra Tech EC, Inc. [TtECI], 2008). Building 88 served as a dry cleaning and laundry facility from approximately 1945 until its closure in 1987. It was located south of Wescoat Road between Severyns Avenue and Dugan Avenue (Figure A2). The building occupied approximately 13,500 square feet and was constructed with a concrete floor, which contained numerous floor drains, floor trenches (assumed to be concrete-lined, but construction specifics could not be verified), and subsurface steel piping for wastewater collection, as shown on Figure A2. The floor drains and piping in the main portion of the building drained into Sump 91, a 700-gallon, single-chamber concrete sump used to collect and store wastewater. The floor drains and piping near the equipment room (northeast portion of the building) received and drained wastewater from the dry cleaning machine area into Sump 66, a 100-gallon concrete sump that was reportedly connected to the sanitary sewer. The equipment room had collection floor trenches that may have drained waste dry cleaning fluids into Tank 68, a 2,000-gallon concrete tank (TtECI, 2008). The sumps, tank, and former Building 88 were removed between 1990 and 1994. Currently, the former Building 88 footprint is a vacant lot.

The branch of the sanitary sewer system that collected wastewater from former Building 88 conveyed the wastewater by gravity: east through the Wescoat Road line, north through the Cummins Avenue line, and eventually to a pump station on the east side of the base (Figure 2 of the Work Plan). The sanitary lines along Wescoat Road and Cummins Avenue are constructed of vitrified clay pipe with invert elevations ranging from 15 to 9 feet above mean sea level (6 to 8 feet below ground surface [bgs]). The section of line along Cummins Avenue immediately downstream of the Wescoat Road line reportedly collapsed and was bypassed with a new line according to the *Final Horizontal Conduit Study Technical Memorandum, Moffett Federal Airfield, California* (PRC Environmental Management, Inc. [PRC], 1995) as illustrated on Figure A2. Wastewater from the Hangar 1 former aircraft wash rack was also discharged to the sanitary sewer line that collapsed along Cummins Avenue (Figure A2). The wastewater originating at the wash rack was collected in a catchment basin and routed to the Sump 25 oil/water separator, which in turn discharged to the Cummins Avenue sanitary sewer line (Figure 2 of the Work Plan). Wash water from the wash rack could have contributed to the CE contamination in the Traffic Island Area via the sanitary sewer conduit because chlorinated VOCs were commonly used to clean aircrafts before the Navy switched to citrus-based solvents in the early 1990s. Sump 25 was removed in May 1994 (PRC, 1996).

10.2 SITE GEOLOGY AND HYDROGEOLOGY

The following subsection provides a brief description of the local geology and hydrogeology at IR Site 28 compiled from the *Final Former Building 88 Investigation Report, Former Naval Air Station Moffett Field, Moffett Field, California* (TtECI, 2008) and *Draft West Side Aquifers Treatment System, Site 28 Optimization Evaluation Report, Installation Restoration Site 28, Former Naval Air Station Moffett Field, Moffett Field, California* (SES-TECH, 2008).

10.2.1 Local Geology

The native subsurface in the IR Site 28 area is characterized by interbedded coarse-grained soil (sand and gravel) and fine-grained soil (silt and clay). Sediments that make up the A-Aquifer represent the distal end of a Holocene-aged coalescing alluvial fan complex and tidal mud flats (estuarine deposits). Near the bay, fine-grained alluvium is replaced by bay mud (dark gray silt and clay). The sand and gravel present represent anastomosing stream channel deposits between inter channel alluvium and bay mud. Fluvial channel deposits typically display fining-upward sequences that begin with a poorly sorted mixture of gravel and coarse sand at the bottom, overlain by a fining-upward sequence of coarse to fine sand, silt, or clay. These channel deposits have been interpreted to generally trend northwest to southeast, and become more northerly in the vicinity of the West Side Aquifers Treatment System (WATS; Tetra Tech FW, Inc. [TtFWI], 2005a).

From the surface to approximately 20 feet bgs, mostly fine-grained soil with isolated coarse-grained deposits are present. Anastomosing, coarse-grained channel deposits are present from approximately 20 feet bgs to approximately 32 feet bgs and are interbedded with fine-grained interchannel deposits. These coarse-grained channel deposits are encased in fine-grained soil, and are present at depth intervals of approximately 20 to 25 feet bgs and 29 to 32 feet bgs. The deposits have been interpreted to represent distinct and continuous channels, but may alternatively represent a series of laterally and vertically interconnected coarse-grained segments of channel fill material. The thickness of the coarse-grained material varies spatially, but averages approximately 2 feet. There appears to be no continuous coarse-grained layer vertically connecting these two intervals (TtECI, 2008).

Two relatively continuous units of coarse-grained channel deposits have been interpreted to be present from approximately 40 to 46 feet bgs and 45 to 52 feet bgs in the western portion of the study area (TtECI, 2008). However, these deposits may represent a series of laterally and vertically interconnected coarse-grained segments of channel-fill material and not distinct channels. The coarse-grained material ranges in thickness from approximately 1 to 6 feet and are separated by approximately 1 to 4 feet of silt.

To better understand the relationships between the interbedded permeable (coarse-grained) and non-permeable (fine-grained) soil layers located beneath and hydraulically downgradient of the

Former Building 88 Area, lithologic data obtained from the soil core and cone penetrometer test (CPT) borings were correlated and a series of geologic cross-sections were generated (TtECI, 2008).

10.2.2 Local Hydrogeology

The focus of this supplemental investigation is the A and B Aquifers. The A-Aquifer extends from grade to approximately 65 feet bgs at IR Site 28. The A-Aquifer is divided into two portions: an upper portion, above 35 feet bgs (sometimes referred to as the A1 zone) and a lower portion below 35 feet bgs (sometimes referred to as the A2 zone) (TtECI, 2008). Based on the absence of a continuous aquitard separating them, these horizons are considered to be portions of the same A-Aquifer rather than independent, discrete aquifers (SES-TECH, 2008). An approximate 10-foot-thick aquitard (referred to as the A/B Aquitard) separates the A and B aquifers at depths ranging from 45 to 80 feet bgs. The B-Aquifer is present below the A/B Aquitard and extends to depths as great as 160 feet bgs. The B-Aquifer can be distinguished from the A-Aquifer by the lack of permeable zones, although discontinuous sand and gravel lenses are present (TtECI, 2008).

Historically, groundwater levels in IR Site 28 monitoring wells in the upper portion of the A-Aquifer exhibited short-term seasonal fluctuations. The high groundwater level typically occurs at the end of the wet season (March). The low groundwater level typically occurs at the end of the dry season (November). Potentiometric surface maps have been prepared biannually to evaluate flow directions and hydraulic gradients using groundwater elevation data collected during March and November. The general groundwater flow direction in the upper and lower A-Aquifer is generally to the north northeast across Moffett at an average gradient of approximately 0.005 foot per foot between U.S. Highway 101 and Hangar 1. The gradient in the general vicinity of Hangar 1 is affected by the WATS pumping; however, the overall flow is north/northeast from Hangar 1 toward the NASA Ames Research Center at a gradient of approximately 0.003 foot per foot (ERS Joint Venture and Brown and Caldwell, 2011).

Upper Portion of the A-Aquifer

Aquifer tests of the upper A-Aquifer indicate unconfined to leaky confined conditions. The hydraulic conductivity calculated from historic slug and pumping tests range from 0.3 to 173 feet per day (ft/day) (TtFWI, 2005b). The high end of this range, with an arithmetic average of 50 ft/day, is indicative of clean sand channels (Freeze and Cherry, 1979). The low range, with an arithmetic average of 11 ft/day, is indicative of silts (Freeze and Cherry, 1979). Total porosities for sand and silt range from 25 to 50 percent, and 35 to 50 percent, respectively (Freeze and Cherry, 1979). Based on the lithology, the estimated average effective porosity is 25 percent for the coarse-grained soil and 12 percent for the fine-grained soil (McWorter and Sunada, 1977). The average groundwater horizontal hydraulic gradient is approximately 0.006 foot per foot in the plume area as measured from the 2010 potentiometric maps. Based on these hydraulic

parameters and using Equation 3-1 in Section 3.3.3.1 of Freeze and Cherry (1979), a groundwater seepage velocity for the coarse-grained soil of 1.2 ft/day was calculated and a seepage velocity of 0.6 ft/day was calculated for the fine grained soil.

Lower Portion of the A-Aquifer

Aquifer tests of the lower A-Aquifer indicate leaky confined conditions. The hydraulic conductivity calculated from historic slug and pumping tests range from 0.1 to 494 ft/day (TtFWI, 2005b). The high end of this range, with an arithmetic average of 136 ft/day, is indicative of clean sand (Freeze and Cherry, 1979). The low range, with an arithmetic average of 11 ft/day, is indicative of silts (Freeze and Cherry, 1979). The porosity and hydraulic gradient are roughly the same as in the upper A-Aquifer (ERS Joint Venture and Brown and Caldwell, 2011). A groundwater seepage velocity for the coarse-grained soil of 3.3 ft/day was calculated and a seepage velocity of 0.6 ft/day was calculated for the fine-grained soil.

A/B Aquitard and B-Aquifer

Based on available information, the B-Aquifer is separated from the overlying A-Aquifer by a continuous clay and clayey silt layer of varying thickness that forms the A/B Aquitard. The A/B Aquitard has been encountered at depths ranging from 45 feet bgs to greater than 80 feet bgs (TtECI, 2008). Generally, the minimum thickness of the A/B Aquitard appears to be about 10 feet. In the areas of investigation targeted by this work plan, only two historical soil borings (W88-1 and W9-12) have been completed deep enough to encounter the A/B-Aquitard. Based on logs for these borings and how the associated B-Aquifer wells were constructed, the A/B-Aquitard appears to have been encountered at approximately 65 feet bgs, was characterized as clay to silty clay with interbedded sandy silt, and ranged from 6 to 14 feet in thickness.

The B-Aquifer extends from approximately 60 feet bgs to 160 feet bgs across IR Site 28. The B-Aquifer is divided into two permeable zones: an upper zone referred to as the B2-Aquifer and a lower zone referred to as the B3-Aquifer that are separated by a laterally discontinuous aquitard (referred to as the B2/B3-Aquitard) encountered at depths ranging from 95 to 111 feet bgs. The B-Aquifer is underlain by the C and deeper aquifers (ERS Joint Venture and Brown and Caldwell, 2011). Limited discontinuous interbedded sands and gravels characterize permeable deposits in the B-Aquifer (TtECI, 2008). Silt and clay predominate in the B-Aquifer underlying Site 28. However, the limited number of permeable layers present in the B-Aquifer appear to be thicker and laterally more continuous than those found in the A-Aquifer (TtECI, 2008). In the areas of investigation targeted by this work plan, only two historical soil borings (W88-1 and W9-12) extended into the upper zone of the B-Aquifer to total depths of 97 and 100 feet bgs, respectively. Boring log interpretations indicate that the upper portion of the B-Aquifer was encountered at approximately 71 and 79 feet bgs, respectively, and was characterized as silts and sands interbedded with sandy, silty clays.

10.3 NATURE AND EXTENT OF CONTAMINATION

As previously discussed, the chemicals of concern are VOCs, primarily PCE and related degradation products within the upper and lower A-Aquifer. Continuing sources of PCE contamination to groundwater were identified in the area of former Building 88 and in the Traffic Island Area beneath the sanitary sewer alignment downstream from former Building 88. A brief summary of the PCE, TCE, cis 1,2-DCE, and VC contamination in these two areas is provided in the following subsections. PCE is specifically described because this was the parent compound originally released to the subsurface at the Former Building 88 Area and Traffic Island Area, making it a key indicator for delineating the Navy's source areas within the regional plume. TCE is specifically described because it is a degradation product of PCE and is the parent compound flowing into IR Site 28 from the upgradient MEW sites. Therefore, TCE concentrations are also useful for delineating the Navy's source areas within the regional plume. Similarly, concentrations of the degradation compounds of PCE and TCE (1,2-DCE and VC) are also useful for delineating the Navy's source areas within the regional plume. The summary was derived from the *Final Former Building 88 Investigation Report* (TtECI, 2008) and is supplemented by recent data collected as presented in the *Final Progress Report, In Situ Anaerobic Biotic/Abiotic Treatability Study, Installation Restoration Site 28, Former Naval Air Station Moffett Field, Moffett Field, California* (Shaw E&I, 2010) and the *Final Technical Memorandum, In Situ Anaerobic Biotic/Abiotic Treatability Study, Installation Restoration Site 28, Former Naval Air Station Moffett Field, Moffett Field, California* (Shaw Environmental, Inc. [Shaw], 2012).

10.3.1 Former Building 88 Area Soil

The former dry cleaning facility (former Building 88) had numerous wastewater collection trenches, floor drains, subsurface piping, and sumps that released PCE into the subsurface. Releases appear to have occurred in two areas: the area of Sump 66 and the former dry cleaning equipment room of former Building 88.

The following description is based on the results of 133 pre- and post-excavation soil samples collected during the 1994 unsaturated zone source removal action (PRC, 1995), 92 soil samples collected from 14 borings during the 2005 site investigation (TtECI, 2008) and 1 soil sample collected from 1 boring during the 2010 – 2011 treatability study (Shaw E&I, 2010). The remaining concentrations of PCE in soil greater than 500 µg/kg (the soil cleanup standard identified in the ROD [EPA, 1989 and 1990]) were only detected in the upper portion of the A-Aquifer from approximately 7 feet bgs (water table) down to 20 feet bgs beneath the former equipment room and down to approximately 35 feet bgs in the vicinity of former Sump 66. The highest concentration of PCE (14,000 µg/kg) was detected in a sample from continuous core IR28SB-01 (April 2010) at a depth of 18 feet bgs, beneath the former equipment room. Much

lower concentrations of PCE (less than 250 µg/kg) were detected outside these areas and did not appear to extend very far beyond the former building footprint.

Similar to PCE, concentrations of TCE above 500 µg/kg (ranging from 530 to 4,400 µg/kg) were detected in the upper portion of the A-Aquifer from 10 feet bgs down to approximately 20 feet bgs beneath the former equipment room and down to approximately 40 feet bgs in the vicinity of former Sump 66. TCE concentrations greater than 500 µg/kg in the upper portion of the A-Aquifer were also detected beneath the former Building 88 southern excavation and former Sump 91 at depths ranging from 11 to 13 feet bgs. The highest concentration of TCE (4,400 µg/kg) encountered in the upper portion of the A-Aquifer was detected in continuous core CC-88-3 at 14 feet bgs beneath the former equipment room. Additionally, concentrations of TCE greater than 500 µg/kg (ranging from 510 to 1,900 µg/kg) were also detected in the lower A-Aquifer in samples from borings located beneath and to the north of the former building footprint at various depths between 37 and 55 feet bgs. The highest concentration of TCE encountered in the lower A-Aquifer (1,900 µg/kg) was detected at approximately 48 feet bgs in continuous core CC-88-2.

Concentrations of cis 1,2-DCE above 500 µg/kg (ranging from 530 to 4,700 µg/kg) were only detected in the upper portion of the A-Aquifer at depths ranging from 10 feet bgs down to approximately 28 feet bgs beneath and in the vicinity of the former equipment room and former Sump 66. Cis 1,2-DCE concentrations greater than 500 µg/kg were also detected beneath the former Building 88 southern excavation and former Sump 91 at depths between 11 and 16 feet bgs. The highest concentration of cis 1,2-DCE (4,700 µg/kg) was detected at a depth of 18 feet bgs in boring IR28-SB01, beneath the former equipment room.

VC was only detected in 3 samples at concentrations ranging from an estimated value of 2.7 µg/kg to 9 µg/kg, with the highest concentration also detected in direct push boring CPT-88-15 at a depth of 17 to 18 feet bgs. Appendix D of the Work Plan provides isoconcentration maps and cross-sections from the 2005 site investigation (TtECI, 2008) that illustrate the distribution of PCE, TCE, cis 1,2-DCE, and VC in soil at the Former Building 88 Area.

To evaluate for the potential presence of dense non-aqueous phase liquids (DNAPLs) at the Former Building 88 Area, during the 2010 – 2011 treatability study (Shaw E&I, 2010), a soil core to 65 feet bgs and a non-aqueous phase liquid FLUTE™ test to 28 feet bgs were completed within the footprint of the former equipment room adjacent to IR28SB-01 and 28MIP-29 where the greatest concentration of CEs in soil were detected. The soil core assessment and FLUTE™ test results provided no indications of DNAPL within the soil core or on the FLUTE™ liner. This included no observations of staining, odor, elevated photoionization detector (PID) responses (greater than 100 parts per million by volume), or positive OilScreenSoil (Sudan IV™) test

results (Shaw E&I, 2010). The negative results along with previous soil and groundwater samples indicate that the amount of potential DNAPL was minimal if present.

Historically, only one boring in the Former Building 88 Area has been drilled into the B2-Aquifer. In 1990, the boring for well W9-12 was advanced to a total depth of 100 feet bgs. This boring is located adjacent to CPT-88-14 in front of Building 6, which is across the street from former Building 88 to the north (Figure A2). No soil samples were collected from the B2-Aquifer for chemical analysis.

10.3.2 Former Building 88 Area Groundwater

The following description is based on the results of 56 discrete-depth groundwater grab samples collected from 10 direct push borings during the 2005 site investigation (TtECI, 2008), 7 groundwater samples collected from the 6 treatability study observation wells prior to the 2010 – 2011 treatability study in July 2010 (Shaw, 2012), and 7 groundwater samples collected from 7 wells outside the treatability study area during the 2010 annual groundwater monitoring event in November/December 2010 (ERS Joint Venture and Brown and Caldwell, 2011). PCE concentrations in A-Aquifer groundwater beneath the Former Building 88 Area ranged from less than the RL of 0.5 µg/L to 19,000 µg/L. Concentrations of PCE in groundwater greater than 1,000 µg/L were detected in the vicinity of the former dry cleaning equipment room and former Sump 66 at depths ranging from 13 feet bgs (1,100 µg/L; CPT-88-1) to 57 feet bgs (2,100 µg/L; CPT-88-15), with the highest concentration (19,000 µg/L) detected between 35 and 40 feet bgs in a sample from well 28OW-23. In the southern and western portion of the former Building 88 footprint, PCE concentrations are less than 20 µg/L in the upper 30 feet bgs (upper portion of the A-Aquifer), and less than the MCL of 5 µg/L in samples collected from below 30 feet bgs (lower portion of the A-Aquifer). Within 200 feet upgradient of former Building 88, PCE was not detected in any of the A-Aquifer well samples collected during the 2010 annual groundwater monitoring event.

Within 200 feet upgradient of former Building 88, TCE was detected in groundwater in the upper portion of the A-Aquifer at concentrations ranging from 39 µg/L (81A) to an estimated value of 810 µg/L (CPT-88-4). In the vicinity of former Building 88, concentrations of TCE in the upper A-Aquifer groundwater ranged from non-detect to 1,400 µg/L. Concentrations of TCE greater than the highest concentration upgradient (810 µg/L) were detected between 11 to 26 feet bgs in the vicinity of former Sump 66 (1,300 µg/L; CPT-88-1) and 32 to 34 feet bgs adjacent to Building 6 (1,400 µg/L; CPT-88-14). Within 200 feet upgradient of former Building 88, TCE was detected in groundwater in the lower portion of the A-Aquifer at concentrations ranging from 560 µg/L (46B1) to 1,800 µg/L (W9SC-20). In the vicinity of former Building 88, concentrations of TCE in lower A-Aquifer groundwater ranged from an estimated value of 270 µg/L to 10,000 µg/L. Concentrations of TCE greater than the highest concentration upgradient (1,800 µg/L) were detected in the vicinity of and downgradient of the former dry

cleaning equipment room, former Sump 66, and former Sump 91 at depths ranging from 35 feet bgs (3,600 µg/L; 29OW-19) to 62 feet bgs (4,300 µg/L; 28OW-20). The highest concentration (10,000 µg/L) was detected at 46 feet bgs in a grab sample from CPT-88-14, located adjacent to Building 6, roughly 75 feet northwest of the former equipment room and Sump 66.

Within 200 feet upgradient of former Building 88, cis 1,2-DCE was detected in groundwater in the upper portion of the A-Aquifer at concentrations ranging from an estimated value of 340 µg/L (CPT-88-4) to 1,500 µg/L (81A). In the vicinity of former Building 88, concentrations of cis 1,2-DCE in the upper A-Aquifer groundwater ranged from 120 µg/L to 3,300 µg/L. Concentrations of cis 1,2-DCE greater than the highest concentration upgradient (1,500 µg/L) were detected between 16 and 25 feet bgs in the vicinity of and downgradient of former Sump 66. The highest concentration (3,300 µg/L) was detected at 17 to 19 feet bgs in a grab sample from CPT-88-14, located adjacent to Building 6. Within 200 feet upgradient of former Building 88, cis 1,2-DCE was detected in groundwater in the lower portion of the A-Aquifer at concentrations ranging from 160 µg/L (46B1) to 460 µg/L (W9SC-20). In the vicinity of former Building 88, concentrations of cis 1,2-DCE in lower A-Aquifer groundwater ranged from 33 µg/L to 5,200 µg/L. Concentrations of cis 1,2-DCE greater than the highest concentration upgradient (460 µg/L) were detected between 35 and 40 feet bgs beneath the former equipment room (5,200 µg/L; 28OW-23) and in the vicinity of former Sump 66 (680 µg/L; CPT-88-1).

Within 200 feet upgradient of former Building 88, VC was detected in groundwater in the upper portion of the A-Aquifer at concentrations ranging from 1.1 to 2.9 µg/L (CPT-88-4). In the vicinity of former Building 88, concentrations of VC in upper A-Aquifer groundwater ranged from 0.57 µg/L to an estimated value of 410 µg/L. Concentrations of VC greater than the highest concentration upgradient (2.9 µg/L) were detected at depths between 10 and 20 feet bgs downgradient of the former equipment room (6.6 to 34 µg/L; CPT-88-15), in front of Building 6 (3.8 µg/L; CPT-88-14), and approximately 45 feet west-northwest of former Sump 91 (estimated 410 µg/L; W9-37). Within 200 feet upgradient of former Building 88, VC was detected in groundwater in the lower A-Aquifer at concentrations of 0.76 µg/L and 0.77 µg/L (CPT-88-4). In the vicinity of former Building 88, concentrations of VC in lower A-Aquifer groundwater ranged from non-detect to 2.2 µg/L. Concentrations of VC greater than the highest concentration upgradient (0.77 µg/L) were detected between 35 and 62 feet bgs beneath and downgradient of the former equipment room and in vicinity of former Sump 66. The highest concentration (2.2 µg/L) was detected in a sample from well 28OW-23, located beneath the former equipment room.

Appendix D of the Work Plan provides cross-sections that illustrate the distribution of PCE, TCE, cis 1,2-DCE, and VC in groundwater at the Former Building 88 Area based on discrete depth grab samples collected during the 2005 site investigation (TtECI, 2008). Appendix D also

contains isoconcentration maps that illustrate the distribution of PCE, TCE, cis 1,2-DCE, and VC in the upper and lower portions of the A-Aquifer based on well samples collected in November/December 2010 after initiation of the 2010 – 2011 treatability study (ERS Joint Venture and Brown and Caldwell, 2011).

Membrane interface probe (MIP) data collected during the 2010 – 2011 treatability study (Shaw E&I, 2010) confirmed that the greatest mass of CEs resides in the northeast portion of the Former Building 88 Area with the greatest electron capture detector (ECD) response recorded at 28MIP-29 beneath the former dry cleaning equipment room (northeast corner of former Building 88). Maximum ECD responses (above the detector calibration range) at this location were recorded from approximately 7 to 56 feet bgs, and the greatest PID responses were recorded between approximately 7 and 17 feet bgs. These elevated detector responses correspond with the highest concentrations of CEs detected in soil and groundwater samples collected previously in and around the former dry cleaning equipment room and Sump 66. The next greatest detector responses were recorded downgradient of 28MIP-29 towards the north-northeast at 28MIP-26 and 28MIP-23.

Isopleth maps of the cumulative ECD response to CEs for the Former Building 88 Area were generated to depict the relative lateral distribution of CEs in three separate depth intervals: 0 to 25 feet bgs, 25 to 49 feet bgs, and 49 to 65 feet bgs (Figures 7, 8, and 9 of the Work Plan, respectively). The distribution of CEs in each of these depth intervals is based on the interval-specific sum of the ECD responses for each MIP test performed in 2010 (Shaw E&I, 2010). As illustrated on Figure 5 of the Work Plan, these intervals represent 3 coarser-grained soil intervals (paleochannels) separated by 2 distinct horizons of fine-grained soil that are stratigraphic features suspected of influencing the distribution and migration of CEs in the subsurface. Copies of the MIP logs from the 2010 – 2011 treatability study are provided in Appendix E of the Work Plan.

Figure 7 shows the highest cumulative ECD response at 28MIP-29 with elevated responses trending towards the northwest in the 0-to-25-feet-bgs interval. Figure 8 also shows the highest cumulative ECD response at 28MIP-29 but exhibits a northeasterly contaminant orientation in a down hydraulic gradient direction in the 25-to-49-feet-bgs interval. CE distribution between 49 and 65 feet bgs is less defined by the MIP results (Figure 9), with the greatest ECD responses adjacent to Building 6 at 28MIP-21 and centered around 28MIP-29 in the northeast portion of the former Building 88 footprint.

Only one well in the Former Building 88 Area is screened in the B2-Aquifer: well W9-12, which is screened from 85 to 95 feet bgs. It was constructed in 1990 and has been sampled 17 times between 1992 and 2010. PCE has not been detected in any of the samples. TCE has been detected in 11 of the samples at a maximum concentration of 2.8 µg /L (2005), below the ROD

cleanup standard (5 µg /L). Cis 1,2-DCE has been detected in 8 of the samples at a maximum concentration of 1.3 µg/L (2009), below its MCL (6 µg /L). VC has not been detected in any of the samples.

10.3.3 Traffic Island Area Soil

Wastewater containing PCE was reportedly discharged from Sump 66 into the sanitary sewer system. Previous investigations determined there was a leak in the sewer line downstream from former Building 88 in the Traffic Island Area. As described in Section 10.1.1, the sewer line reportedly collapsed and resulted in the release of PCE into the subsurface.

The following description is based on the results of 50 soil samples collected from 8 borings during the 2005 site investigation (TtECI, 2008) and 1 soil sample collected from 1 boring during the 2010 – 2011 treatability study (Shaw E&I, 2010). Concentrations of PCE in A-Aquifer soil greater than 500 µg/kg (the unsaturated soil cleanup standard identified in the ROD [EPA, 1989 and 1990]) were detected from 8 feet bgs (water table) down to 60 feet bgs along the sanitary sewer alignment beneath the traffic island where the sewer line had reportedly collapsed. The highest concentration of PCE in soil (7,000 µg/kg) was detected in a sample from direct push boring CPT-88-13 at a depth of 8 to 9 feet bgs beneath the traffic island.

A TCE concentration greater than 500 µg/kg in A-Aquifer soil was only detected in a sample from direct push boring CPT-88-13 (770 µg/kg) at a depth of 8 to 9 feet bgs beneath the traffic island. Cis 1,2-DCE concentrations greater than 500 µg/kg in A-Aquifer soil were detected between 8 to 19 feet bgs in direct push boring CPT-88-13 (700 to 3,700 µg/kg) and between 11 to 12 feet bgs in direct push boring CPT-88-23 (1,100 µg/kg). VC was only detected in 2 samples from direct push borings CPT-88-13 and CPT-88-16 at an estimated concentration of 2 µg/kg (15 to 16 feet bgs) and 14 µg/kg (8 to 9 feet bgs), respectively. Appendix D of the Work Plan provides isoconcentration maps and cross-sections from the 2005 site investigation (TtECI, 2008) that illustrate the distribution of PCE, TCE, cis 1,2-DCE, and VC in soil at the Traffic Island Area.

To evaluate for the potential presence of DNAPLs in the lower portion of the A-Aquifer at the Traffic Island Area, during the 2010 – 2011 treatability study (Shaw E&I, 2010), a continuous soil core (IR28SB-02) and a non-aqueous phase liquid FLUTE™ test were completed to a total depth of 65 feet bgs, adjacent to the MIP boring with the greatest ECD and PID response, 28MIP-12. No indications of DNAPL were noted in the soil core or were present on the liner. This included no observations of staining, odor, elevated PID responses (greater than 100 parts per million by volume), or positive OilScreenSoil (Sudan IV™) test results (Shaw E&I, 2010). In addition, a second non-aqueous phase liquid FLUTE™ test was performed adjacent to 28MIP-05, where the greatest combined ECD and PID responses were detected in the upper portion of the A-Aquifer (Figure 11 of the Work Plan). The liner was deployed to a total depth of

30 feet bgs targeting the upper portion of the A-Aquifer. No indications of DNAPL were present on the liner. Based on the negative results for the non-aqueous phase liquid FLUTE™ tests along with previous soil and groundwater samples from the A-Aquifer, it was concluded that the potential amount of DNAPL PCE beneath the Traffic Island Area, if present, is sufficiently small (Shaw E&I, 2010).

Historically, only 1 boring in the Traffic Island Area has been drilled into the B2-Aquifer. During the 2005 site investigation, direct push boring CPT-88-13 was overdrilled by the boring for well W88-1 to a total depth of 97 feet bgs. This boring/well is located adjacent to the sanitary sewer line that reportedly collapsed beneath the traffic island (Figure A3). Only two soil samples were collected from W88-1, at depths of 70 and 73 feet bgs. PCE was detected in both samples at concentrations of 10,000 µg/kg and 8,700 µg/kg, respectively. TCE was detected at 1,900 µg/kg and 1,300 µg/kg, respectively. Cis 1,2-DCE was detected at 18 µg/kg and 6 µg/kg, respectively. VC was detected at 8.7 µg/kg and an estimated value of 2.3 µg/kg, respectively.

10.3.4 Traffic Island Area Groundwater

The following description is based on the results of 53 discrete-depth groundwater grab samples collected from 8 direct push locations during the 2005 site investigation (TtECI, 2008), 15 groundwater samples collected from the 14 treatability study observation wells prior to the 2010 – 2011 treatability study in July 2010 (Shaw, 2012), and 4 groundwater samples collected from 4 wells outside the treatability study area during the 2010 annual groundwater monitoring event in November/December 2010 (ERS Joint Venture and Brown and Caldwell, 2011). PCE concentrations in A-Aquifer groundwater ranged from less than the RL of 0.5 µg/L to 28,000 µg/L. Concentrations of PCE in groundwater greater than 1,000 µg/L were primarily detected along the sanitary sewer alignment beneath and north of the traffic island at depths ranging from 14.5 feet bgs (9,200 µg/L; CPT-88-13) to 65 feet bgs (28,000 µg/L; 28-OW-12). Within 200 feet upgradient (south) of the traffic island PCE concentrations ranged from less than the RL of 0.5 µg/L (CPT-88-16 and CPT-88-17) to 5.2 µg/L (28-OW-10) between 8 and 51 feet bgs.

Within 200 feet upgradient of the traffic island, TCE was detected in groundwater in the upper portion of the A-Aquifer at concentrations ranging from 21 µg/L (28OW-09) to 900 µg/L (CPT-88-16). In the vicinity of the traffic island, concentrations of TCE in upper A-Aquifer groundwater ranged from non-detect to 2,400 µg/L. Concentrations of TCE greater than the highest concentration upgradient (900 µg/L) were only detected between 14 and 19 feet bgs beneath the traffic island at direct push boring CPT-88-13, located adjacent to the sanitary sewer line that reportedly collapsed. Within 200 feet upgradient of the traffic island, TCE was detected in groundwater in the lower portion of the A-Aquifer at concentrations ranging from 6.9 µg/L (CPT-88-17) to 620 µg/L (CPT-88-16). In the vicinity of the traffic island, concentrations of TCE in lower A-Aquifer groundwater ranged from lower than the RL of 0.5 µg/L to

12,000 µg/L. Concentrations of TCE greater than the highest concentration upgradient (620 µg/L) were detected beneath, to the west-southwest (CPT-88-20 and CPT-88-21), and north-northwest (CPT-88-19) of the traffic island at depths ranging from 39 to 65 feet bgs. The highest concentration (12,000 µg/L) was detected in a sample from well 28OW-04 (55 to 65 feet bgs), located adjacent to the sanitary sewer line that reportedly collapsed and directly above the A/B-Aquitard.

Within 200 feet upgradient of the traffic island, cis 1,2-DCE was detected in groundwater in the upper portion of the A-Aquifer at concentrations ranging from 190 µg/L (28OW-10) to 1,700 µg/L (28OW-09). In the vicinity of the traffic island, concentrations of cis 1,2-DCE in upper A-Aquifer groundwater ranged from non-detect to 11,000 µg/L. Concentrations of cis 1,2-DCE greater than the highest concentration upgradient (1,700 µg/L) were only detected between 14 and 19 feet bgs beneath the traffic island at direct push boring CPT-88-13, located adjacent to the sanitary sewer line that reportedly collapsed. Within 200 feet upgradient of the traffic island, cis 1,2-DCE was detected in groundwater in the lower portion of the A-Aquifer at concentrations ranging from 1.8 µg/L (CPT-88-17) to an estimated value of 120 µg/L (CPT-88-16). In the vicinity of the traffic island, concentrations of cis 1,2-DCE in lower A-Aquifer groundwater ranged from non-detect to 5,000 µg/L. Concentrations of cis 1,2-DCE greater than the highest concentration upgradient (120 µg/L) were detected beneath, to the west-southwest (CPT-88-20 and CPT-88-21), and north-northwest (W9-21) of the traffic island at depths ranging from 35 to 65 feet bgs. The highest concentration (5,000 µg/L) was detected in a sample from well 28OW-04 (55 to 65 feet bgs), located adjacent to the sanitary sewer line that reportedly collapsed and directly above the A/B-Aquitard.

Within 200 feet upgradient of the traffic island, VC was detected in groundwater in the upper portion of the A-Aquifer at concentrations ranging from an estimated value of 0.28 µg/L (28OW-10) to 170 µg/L (WNX-2). No concentrations of VC greater than 170 µg/L (the highest upgradient concentration) were detected in the vicinity of the traffic island. Concentrations of VC in vicinity of the traffic island ranged from non-detect to 140 µg/L, with approximately half of the concentrations less than 1 µg/L. Concentrations above 1 µg/L were detected beneath, to the west-southwest (CPT-88-20 and CPT-88-21), and to the north-northwest (CPT-88-23 and CPT-88-19) of the traffic island at depths ranging from 7 to 39 feet bgs. The highest concentration (140 µg/L) was detected in a sample from well W9-42 (29 to 39 feet bgs), located beneath the traffic island approximately 25 feet northeast of the sanitary sewer line that reportedly collapsed. Within 200 feet upgradient of the traffic island, VC was not detected in groundwater in the lower portion of the A-Aquifer. In the vicinity of the traffic island, concentrations of VC in lower A-Aquifer groundwater ranged from non-detect to 600 µg/L. Concentrations of VC greater than the RL (0.5 µg/L) were detected beneath, to the southwest (CPT-88-20), and to the north-northwest (W9-21) of the traffic island at depths ranging from 39

to 65 feet bgs. The highest concentration (600 µg/L) was detected in a sample from well 28OW-04 (55 to 65 feet bgs), located adjacent to the sanitary sewer line that reportedly collapsed and directly above the A/B-Aquitard.

Appendix D of the Work Plan provides cross-sections that illustrate the distribution of PCE, TCE, cis 1,2-DCE, and VC in groundwater at the Traffic Island Area based on discrete depth grab samples collected during the 2005 site investigation (TtECI, 2008). Appendix D also contains isoconcentration maps that illustrate the distribution of PCE, TCE, cis 1,2-DCE, and VC in the upper and lower portions of the A-Aquifer based on well samples collected in November/December 2010 after initiation of the 2010 – 2011 treatability study (ERS Joint Venture and Brown and Caldwell, 2011),

Directly beneath the traffic island, there is an apparent increase in PCE and TCE concentrations with depth as indicated by pre-treatment groundwater sample results from the 2010 – 2011 treatability study wells (Shaw, 2012). The results indicate higher PCE and TCE concentrations at depth, notably within the 40-to-50-feet-bgs and 55-to-65-feet-bgs intervals. The highest observed PCE concentrations, 15,000 and 28,000 µg/L, were detected in samples from wells 28OW-04 and 28OW-12, respectively. Both of these wells are screened from 55 to 65 feet bgs (Shaw, 2012). TCE in these samples were 12,000 and 7,800 µg/L, respectively. PCE and TCE concentrations in samples from wells screened in shallower intervals (12 to 17 feet bgs [28OW-01 and 28OW-05] and 24 to 29 feet bgs [28OW-02 and 28OW-06]) ranged from 19 to 230 µg/L and from 17 to 370 µg/L, respectively.

MIP data collected during the 2010 – 2011 treatability study (Shaw E&I, 2010) confirmed that the greatest mass of CEs resides below the alignment of the collapsed sanitary sewer line. The greatest ECD response profile(s) from the 19 MIP tests performed in the Traffic Island Area were recorded at 28MIP-09, 28MIP-11, and 28MIP-12, which are located along the former collapsed sanitary sewer alignment at the southwest corner of the Traffic Island Area. Maximum ECD responses (above the detector calibration range) at these locations were recorded from approximately 7 to 65 feet bgs, and the greatest PID responses were recorded from approximately 7 to 25 feet bgs and 47 to 55 feet bgs (Shaw E&I, 2010). These test locations correspond with the high concentrations of CEs detected in groundwater samples collected at CPT-88-13, 28OW-04, and 28OW-12, along the upstream portion of the former collapsed sanitary sewer alignment. Down hydraulic gradient of these locations, the ECD responses decline in the upper portion of the A-Aquifer but remain high in the lower portion of the A-Aquifer, below 35 feet bgs. Copies of the MIP logs from the 2010 – 2011 treatability study are provided in Appendix E of the Work Plan.

Similar to the Former Building 88 Area, isopleth maps of the cumulative ECD response for the Traffic Island Area were generated to depict the relative lateral distribution of CEs in

three separate depth intervals: 0 to 23 feet bgs, 23 to 46 feet bgs, and 46 to 65 feet bgs (Figures 10, 11, and 12 of the Work Plan, respectively). As illustrated on Figure 6 of the Work Plan, these intervals represent 3 coarser-grained soil intervals (paleochannels) separated by two distinct horizons of fine-grained soil that are stratigraphic features suspected of influencing the distribution and migration of CEs in the subsurface.

Figure 10 shows the highest cumulative ECD responses in the 0-to-23-feet-bgs interval (greater than 4×10^9 microvolts [μV]) aligned in a north-northwest orientation along the western side of the former collapsed sanitary sewer line. Similarly, Figure 11 also exhibits a north-northwest alignment of the highest cumulative ECD responses in the 23-to-46-feet-bgs interval (greater than 6×10^9 μV) along the former collapsed sanitary sewer line. Figure 12 shows the highest cumulative ECD responses in the 46-to-65-feet-bgs interval (greater than 5×10^9 μV) aligned in a northern orientation along the former collapsed sanitary sewer line.

It should be noted that at test location 28MIP-01, between 15 and 25 feet bgs, high PID and flame ionization detector responses were observed but with only a slight ECD response. Based on these responses and considering the detection capabilities of each instrument, it is possible that an organic compound other than CEs was detected at this location/interval.

Only one well in the Traffic Island Area is screened in the B2-Aquifer: well W88-1, which is screened from 72 to 82 feet bgs. It was constructed in 2005 and has been sampled 4 times between 2005 and 2010. PCE was initially detected at an estimated concentration of 69 $\mu\text{g/L}$ (2005) and by 2010 it had increased to a maximum estimated concentration of 3,300 $\mu\text{g/L}$. Similarly, TCE was initially detected at an estimated concentration of 31 $\mu\text{g/L}$ (2005) and by 2010 it had increased to a maximum estimated concentration of 2,200 $\mu\text{g/L}$. Conversely, cis 1,2-DCE was initially detected at 9,700 $\mu\text{g/L}$ but by 2010 it had decreased to an estimated concentration of 4,500 $\mu\text{g/L}$. VC was not detected initially in 2005 but was detected in all subsequent samples and by 2010 it had increased to a maximum estimated concentration of 290 $\mu\text{g/L}$.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

Step	Project Quality Objectives
1	Define the problem that necessitates the study
	<p>The A-Aquifer at IR Site 28 is impacted by VOCs, primarily CEs, which resulted from on-site Navy sources and on-flow of contamination from upgradient VOC sources at the MEW Superfund Site. The MEW companies, Navy and NASA all have sources that contributed CEs to the regional plume. A pump and treat system is currently in operation at the site to address dissolved VOCs in the A-Aquifer. The EPA is preparing a feasibility study report for the regional groundwater plume, to evaluate the ability of several remedial alternatives that include technologies other than pump and treat, to reduce concentrations of CEs and remediate the regional plume. All of the alternatives evaluated in the EPA's feasibility study include source treatment. Although prior investigations have provided valuable insight into the nature and extent of the Navy's source areas, several key data gaps remain in the CSM for the Former Building 88 and Traffic Island Areas that need to be addressed before further remediation can be designed. Additionally, since 2005, results of soil and groundwater sampling conducted in the Traffic Island Area have suggested that the B-Aquifer, which underlies the A-Aquifer, may also be impacted by CEs with increasing concentrations in groundwater. The purpose of this supplemental investigation is to augment the current understanding of IR Site 28 CE contamination at the Former Building 88 and Traffic Island Areas.</p>
2	Identifying the goal of the study
	<p>The primary goal of the study is to refine the understanding of the soil stratigraphy and the horizontal and vertical extent of PCE and its daughter products (TCE, DCE, and VC) in the saturated zone at the Former Building 88 and Traffic Island source areas.</p> <p>The following Site Investigation study questions are:</p> <ul style="list-style-type: none"> • What are the concentrations and distribution of PCE and its daughter products (TCE, DCE, and VC) in the A-Aquifer within and around the Former Building 88 and Traffic Island source areas? • What is the depth to and lateral continuity of the A/B Aquitard in the Traffic Island Area? • What is the depth to the top of the B2-Aquifer in the Traffic Island Area? • Is monitoring well W88-1 screened in the B2-Aquifer? • Is the B-Aquifer beneath the Traffic Island Area impacted by CEs above the ROD cleanup standards and MCLs (EPA, 1989)?
3	Identifying information inputs
	<p>To support the project decisions for the Supplemental Investigation, the Navy Site Characterization Analysis Penetrometer System (SCAPS) will be used initially to further define the soil stratigraphy and concentrations of PCE and its daughter products within and around the Former Building 88 and Traffic Island source areas. A review of previously collected data was performed to determine where to place the proposed SCAPS test locations. The SCAPS will generate soil stratigraphy data using a CPT tool and semi-quantitative VOC concentration data using a MIP combined with a direct sample ion-trap mass spectrometer (DSITMS). Currently there are only a limited number of locations that provide soil stratigraphy information below 65 feet bgs. Upon completion of the SCAPS survey, the SCAPS data along with existing site data will be evaluated following a triad approach to identify locations for new monitoring wells that will be used to directly quantify concentrations of PCE and its daughter products in groundwater.</p>

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Step	Project Quality Objectives
3 (cont.)	<p>Identifying information inputs</p> <p>Existing data inputs include:</p> <ul style="list-style-type: none"> • Soil stratigraphy data from previous soil borings, CPT tests, and MIP tests • Analytical data for soil and groundwater samples collected during previous investigations, removal actions, treatability study tests, and annual groundwater sampling <p>New data inputs will include:</p> <ul style="list-style-type: none"> • Soil stratigraphy data from the SCAPS survey and new monitoring well(s) boreholes • Semi-quantitative concentrations of VOCs in the saturated zone from the SCAPS survey • Analytical data for soil samples collected from the new monitoring well(s) boreholes <p>Analytical data for groundwater samples collected from new monitoring wells</p>
4	<p>Define the boundaries of the study</p> <p>IR Site 28 encompasses approximately 63 acres. Two separate areas of interest within IR Site 28 (Former Building 88 Area and Traffic Island Area; Figures A2 and A3) are proposed for the investigation using SCAPS and well installation. The period of performance for this investigation and sampling effort extends to winter 2013. The field portion of the study will be performed within a one year period. Depth to groundwater in the A-Aquifer is approximately 5 to 8 feet bgs and depth to groundwater in the B-Aquifer is greater than 65 feet bgs. The depth of investigation (SCAPS survey and wells installation) will range from surface to a depth of about 65 feet bgs in the Former Building 88 Area and a maximum depth of approximately 100 feet bgs in the Traffic Island Area.</p> <p>Constraints to data collection at the site include a fixed project budget, a limitation of the maximum depth the SCAPS can reach due to a fixed umbilical length or refusal from subsurface resistance to tool penetration, surface obstructions such as buildings, and subsurface obstructions such as buried utilities. There is burrowing owl habitat nearby, but the presence of the owl should not impact field activities. Possible access restriction for locations inside Hangar 1 may be present due to an ongoing remedial action. Access will be arranged through the Resident Officer in Charge of Construction, Air Field Security, NASA and the remedial contractor prior to field work. Normal weather patterns should not impact site activities.</p>
5	<p>Develop the analytic approach</p> <p>The site investigation decisions for the SCAPS survey will follow a triad approach:</p> <p>Each area will have designated starting points for the SCAPS survey; identified as Tier 1 test locations (SCAPS-1 through SCAPS-28 on Figures A2 and A3).</p> <p>Tiered step-out sampling will occur after the Tier 1 tests have been completed. A review of the results for the Tier 1 tests along with previously collected data will be performed to identify potential locations for the Tier 2 tests. A Triad meeting will be held to review, refine, and mutually agree on the Tier 2 test locations.</p> <ul style="list-style-type: none"> • If all the MIP/DSITMS results for the target CEs are less than 1,000 µg/L of calibration solution at a Tier 1 test location, then the extent of the source area contamination has been identified and Tier 2 step-out test location(s) will not be performed, but potential Tier 2 step-in test(s) may be performed with locations approved by the Triad team.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Step	Project Quality Objectives
5 (cont.)	<p>Develop the analytic approach</p> <ul style="list-style-type: none"> <li>• If a MIP/DSITMS result for the target CEs are greater than 1,000 µg/L and less than 10,000 µg/L of calibration solution at a Tier 1 test location, then the extent of the source area may not be identified and Tier 2 step-out test(s), up to 50 feet from the Tier 1 location in a direction that is radially outward from the defined source area, may be performed with approval of the Triad team. <li>• If the MIP/DSITMS results for the target CEs are greater than 10,000 µg/L of calibration solution at a Tier 1 test location, then the extent of the source area has not been identified and Tier 2 step-out test(s), up to 50 feet from the Tier 1 location in a direction that is radially outward from the defined source area, will be performed with approval of the Triad team. <li>• If a MIP/DSITMS result for PCE or TCE is greater than 50,000 ug/L of calibration solution, then mobile DNAPL is possibly present and the MIP/DSITMS test will be terminated at the top of the A/B-Aquitard to prevent cross-contamination of the B2-Aquifer. <li>• If a MIP/DSITMS result for PCE or TCE is less than 50,000 ug/L of calibration solution, then mobile DNAPL is not considered to be present and the MIP/DSITMS test may be advanced through the A/B-Aquitard into the B2-Aquifer. <li>• If the CPT identifies a predominantly clay soil at least 2-feet in thickness between 65 and 70 feet bgs, then it is assumed to be the A/B-Aquitard. <li>• If the CPT does not identify a 2-foot thick predominantly clay soil between 65 and 75 feet bgs then the A/B-Aquitard will be considered absent. <li>• If the CPT encounters a predominantly sand soil following penetration of the A/B-Aquitard, then it is assumed to be the top of the B2-Aquifer. <li>• If the CPT data indicate well W88-1 is screened in the B2-Aquifer, then the groundwater monitoring results for W88-1 are representative of water quality conditions in the B2-Aquifer beneath the traffic island. <li>• If the CPT data do not indicate well W88-1 is screened in the B2-Aquifer, then the groundwater monitoring results for W88-1 are not representative of water quality conditions in the B2-Aquifer.
6	<p>Specifying performance or acceptance criteria</p> <p>To limit uncertainty in the obtained environmental data, criteria for the precision, accuracy, representativeness, completeness, and comparability parameters and reporting limits for the chemicals of concern have been developed (WS #12.1, "Measurement Performance Criteria Table—Field QC Samples (Soil)" and WS #28.1, "Laboratory QC Samples Table"). Measurement errors will be controlled by using appropriate sampling and analytical methods, adhering to the DoD QSM (2010), following established SOPs, and having the project chemist performing data validation to verify laboratory processes. The field crews will be trained in applicable sample collection procedures and will review the SAP before sample collection to limit sample collection errors. The subcontract analytical laboratories will have a copy of the SAP and will adhere to DoD QSM guidance to limit measurement errors. MIP data is considered screening level data (qualitative to semi-quantitative) and to limit the uncertainty in the data, the subcontractor will follow the MIP operation SOP (included with the Final SAP). The MIP operator will calibrate daily (described in WS #22) and data will be considered usable as screening level data if daily calibration meets the requirement of the operators SOPs.</p>

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements (continued)

Step	Project Quality Objectives
7	Plan the design for obtaining data
<p>A SCAPS survey will be performed within two areas of interest at IR Site 28 (Former Building 88 Area and Traffic Island Area) to further refine the understanding of the soil stratigraphy and the horizontal and vertical extend of PCE and its daughter products in these areas. The SCAPS data in conjunction with historical MIPs, CPT, soil sample, and groundwater sample data will be used to identify locations for new monitoring wells in the two areas of interest. Groundwater sampling will be conducted on the newly installed monitoring wells. All monitoring wells will be sampled twice (approximately 2 quarterly events) for this project.</p>	

SAP Worksheet #12.1—Measurement Performance Criteria Table—Field QC Samples (Soil)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicates	VOCs	None—soil samples will be collected in the areas with high MIPS/DSITMS response where high variability is expected	Precision	Not Applicable	S&A
Matrix Spikes	VOCs	None—soil samples will be collected in the areas with high MIPS/DSITMS response matrix spikes cannot be evaluated in highly contaminated matrix	Accuracy	Not Applicable	A
Temperature Blanks	VOCs	Every cooler shipped to the laboratory	Representativeness	4 plus or minus (\pm) 2 degrees Celsius ($^{\circ}$ C)	S

SAP Worksheet #12.2—Measurement Performance Criteria Table—Field QC Samples (Water)

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicates	VOCs	One per 10 field samples collected	Precision	30 percent (%) - Relative percent difference (RPD)	S&A
Rinse Blanks	VOCs	None—if disposable sampling equipment is used, one per day if using non-disposable sampling equipment	Representativeness Bias Contamination	Analytes not detected above limits of quantitation (LOQs)	S
Matrix Spikes	VOCs	5%—One per 20 field samples collected	Precision and Accuracy	DoD QMS (2010) Control Limits if available; otherwise Laboratory Control Limits (Attachment 3)	A
Trip Blanks	VOCs	One per each day of sampling	Representativeness Bias Contamination	Analytes not detected above LOQs	S
Temperature Blanks	VOCs Dissolved gasses	Every cooler shipped to the laboratory	Representativeness	4 ± 2 °C	S

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation/collection dates)	How Data Will Be Used	Limitations on Data Use
Groundwater data	<p>Shaw, 2012, <i>Final Technical Memorandum, In Situ Anaerobic Biotic/Abiotic Treatability Study, IR Site 28, Former Naval Air Station Moffett Field, Moffett Field, California, March.</i></p> <p>ERS Joint Venture and Brown and Caldwell, 2011, <i>Final 2010 Annual Groundwater Report for Installation Restoration Sites 26 and 28, Former Naval Air Station Moffett Field, Moffett Field, California, June.</i></p> <p>TtECI, 2008, <i>Final Former Building 88 Investigation Report, Former Naval Air Station Moffett Field, Moffett Field, California, March .</i></p>	<p>Shaw, soil and groundwater VOC data, 2010 – 2011</p> <p>ERS Joint Venture and Brown and Caldwell, groundwater VOC data, 2010</p> <p>TtECI, soil and groundwater VOC data, 2005</p>	Used to establish initial SCAPS locations for investigation	None

SAP Worksheet #14—Summary of Project Tasks

14.1 SCOPE OF WORK

The scope of work for this project includes:

- Utility locating
- Concrete coring
- SCAPS investigation
- Soil sampling associated with new monitoring well installation
- Installation of up to 12 new monitoring wells
- Well development of all new wells
- Groundwater sampling
- Surveying
- Equipment decontamination
- Analytical requirements
- QC samples
- Waste characterization/disposal
- Data review and validation

14.2 SAMPLE COLLECTION METHODS AND PROCEDURES

The following sections describe the sampling methods and procedures that will be used to collect samples for this project. Procedures for monitoring well installation and surveying are provided in Work Plan Sections 6.0 and 4.3, respectively.

14.2.1 Soil Sampling During Well Installation

Soil samples will be collected during the installation of new monitoring wells. The new wells will be installed through the use of Sonic drilling techniques. Soil samples will be collected using the sampling procedure described below:

1. Continuous soil cores are obtained from the Sonic rig in plastic core bags.
2. Put on a new, clean, and chemical-resistant pair of disposable gloves prior to taking the sample.
3. Cut open the plastic core bag and expose soil for visual logging, PID screening, and sample collection. Samples for lab analysis will be collected at the core center from

depth intervals with the highest CE concentration detected during the MIP/DSITMS testing or as measured with field instruments (i.e., PID) while logging the soil core. The samples will be collected into the En Core[®] sampler (see Section 14.2.2).

4. Label, package, and prepare the samples for shipment to the laboratory. Transfer the samples to cold storage after collection.

14.2.2 En Core[®] Soil Sampling for VOCs

5. Obtain En Core[®] device and T-handle (or equivalent).
6. Put on a new, clean, and chemical-resistant pair of disposable gloves prior to taking the sample, the Sample Technician will test the plunger free movement by pushing the plunger rod down until it rests against the tabs.
7. The locking lever on the En Core[®] T-Handle must be depressed as the cartridge is inserted. Line up the slots on the cartridge with the locking pins in the T-Handle. Plunger end first, insert cartridge into T-Handle with locking tabs aligned and twist cartridge clockwise locking the cartridge in place.
8. Apply En Core[®] to freshly exposed center of sonic core or from one end of a sleeve core (if using a split-spoon sampler) as soon as it is brought to the surface. Holding the device with the T-Handle up and the cartridge down, insert the sampling device into the soil. The coring body must be full, by checked to make sure the plunger end is seen in the viewing hole. Withdraw sampling device from soil and wipe of excess dirt from cartridge body.
9. The cartridge core is capped while it is still on the T-Handle. Push or twist cap on until the groves are seated over the ridge of the coring body.
10. Remove the capped sampler by pushing down locking lever on T-Handle and twisting and pulling sampler from T-Handle. The plunger is locked by rotating the plunger rod until the wings rest against the tabs. Attach the label and seal the cartridge in the En En Core[®] sampler bag.
11. The En Core[®] sampler holding time is 48 hours. Soil samples are shipped to the laboratory for preservation or freezing within the 48-hour holding time. After preservation, the soil sample can be held up to 14 days for analysis.
12. Store the En Core[®] sampler bag in a cooler with ice until it can be delivered to the laboratory.

14.2.3 Groundwater sampling

Groundwater monitoring wells will be sampled in accordance with the procedures described in this section. The wells will be purged with a portable bladder pump using low-flow technique, prior to sampling.

The following standard procedures will be followed when sampling a monitoring well:

1. Don appropriate personal protective equipment,.
2. Confirm the well identification at each monitoring/observation well.
3. Calibrate field instruments in accordance with the manufacturer's directions. Record all calibration documentation in the field logbook.
4. Measure the depth to water at each well using an electronic water level indicator probe. Record the water level measurement to the nearest 0.01 of a foot in the field logbook. Decontaminate the water level indicator before each measurement according to the procedure in Section 14.3.
5. Carefully lower the pump or tubing into the well. Each well will have dedicated tubing for sampling. Place the intake to the pump at the middle of the screen interval. The pump speed will be set so that the water column in the well does not continually drop during purging. The flow rates should range between 300 and 500 milliliters (mL) per minute. However, slower purge rates may be necessary to maintain water level requirements. The pump rate should be set so that a constant water level (with minimal drawdown of 0.3 feet) is maintained.
6. Monitor water quality parameters (i.e., dissolved oxygen [DO], conductivity, pH, oxygen reduction potential [ORP], and temperature) every 3 to 5 minutes during purging using in-line meters. Record the water quality parameters on the groundwater sampling log form. If the water quality parameters are stable for three consecutive readings, collect samples for chemical analysis. Stabilization is achieved if successive readings are within ± 0.1 pH units, $\pm 1^\circ\text{C}$ for temperature, 3 percent conductivity, ± 10 mV ORP, and 10 percent DO readings. Turbidity readings will be collected but will not be used as a stabilization parameter. If the water quality parameters have not stabilized, continue purging until stabilization occurs or three calculated well volumes have been purged.
7. Reduce the pump flow to a rate of less than 300 mL per minute, and collect samples.

Note: Do not stop the pump after stabilization and prior to sample collection.

8. Collect samples from the discharge of the pump; fill the appropriate sample containers, shown in WS #19. Collect field QC samples (e.g., field duplicates) as required.
9. Label, package, and prepare the samples for shipment to the laboratory. Transfer the samples to cold storage after collection.

14.2.5 PID operation

A portable PID may be used at sites to screen soil for evidence of VOC contamination. The PID measures the presence of volatile ionizable contaminants in vapor. The PID will be operated and

calibrated daily according to the manufacturer's directions. The procedure for PID operation is summarized below:

1. Turn on instrument according to the manufacturer's directions and allow the lamp to stabilize.
2. Establish "zero" for the PID calibration using atmospheric air.
3. Verify the instrument is in calibration by reading a known concentration, usually 50 to 100 parts per million by volume of iso-butylene in air. If the instrument reading is more than 20 percent off from the true value, recalibrate the PID following manufacturer's directions.
4. Attach inlet of the meter to the location requiring monitoring (i.e., sealed plastic bag or jar containing soil left in a warm location for approximately 10 minutes)
5. Collect the reading from the instrument, and record it in the field logbook.

14.3 EQUIPMENT DECONTAMINATION

Decontamination of non-disposable sampling equipment that comes in contact with samples (such as a submersible pump) will be performed to prevent the introduction of extraneous material into samples, and to prevent cross-contamination between samples. All sampling equipment will be decontaminated by washing with a non phosphate detergent such as Liquinox™ or equivalent. Decontamination water will be collected in 55-gallon U.S. Department of Transportation-approved drums or a poly-tank.

The following procedures will be used for decontamination of non disposable sampling equipment:

1. If mud or soil is adhering to the sampling equipment, first rinse with potable water. This step will decrease the gross contamination and reduce the frequency at which the non phosphate detergent and water solution need to be changed.
2. Wash with the non phosphate detergent and water solution. This step will remove remaining contamination from the equipment. Dilute the non phosphate detergent as directed by the manufacturer.
3. Rinse with potable water. Change the water frequently.
4. Rinse with deionized water. This step will rinse any detergent solution and potable water residues. Rinsing will be done by applying the deionized water from a clean squeeze bottle (or equivalent) while holding equipment over a bucket.

14.4 ANALYTICAL REQUIREMENTS

Soil and groundwater samples for this project will be analyzed for the following parameters:

Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846, Update III (EPA, 1996b):

- VOCs by EPA Method 8260B

The above analytical method will be performed according to the applicable EPA and QC requirements in the DoD QSM (2010) as shown in WS#24 and WS#28.

The following analysis will be performed following manufacturer directions or proprietary Laboratory specific SOPs, as applicable.

- Dissolved gasses by Microseeps Method AM20GAX

14.5 DATA MANAGEMENT

This section describes the data management procedures for data review, verification, reporting, and validation.

14.5.1 Laboratory Data Reduction, Verification, and Reporting

All analytical data generated by the laboratory projects will be reviewed prior to reporting to assure the validity of reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks, that will be signed and dated by the reviewer.

14.5.2 Data Reduction

Data reduction involves the mathematical or statistical calculations used by the laboratory to convert raw data to the reported data. The laboratory will perform a reduction of analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. For each method, all raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

All data calculations will be verified and initialed by personnel both generating and approving them. All raw and electronic data, notebook references, supporting documentation, and correspondence will be assembled, packaged, and stored for a minimum of 10 years for future use. All reports will be held client confidential. If the laboratory is unable to store project-related data for 10 years, then it is the responsibility of the laboratory to contact Shaw E&I to make alternative arrangements.

14.5.3 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of data is essential in ensuring that data of known quality are generated consistently. All data generated and reduced will follow well-documented in-house protocols.

Level 1. Technical (Peer) Data Review

Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method, in this SAP, and as stated within the laboratory QA Manual. This review will, at a minimum, ensure that the following conditions have been met:

- Sample preparation information is correct and complete
- Analysis information is correct and complete
- Appropriate SOPs have been followed
- Calculations are verified
- There are no data transposition errors
- Analytical results are correct and complete
- QC samples are within established control limits
- Blanks and laboratory control samples (LCSs) are within appropriate QC limits
- Special sample preparation and analytical requirements have been met

Documentation is complete, for example, any anomalies and holding times have been documented and forms have been completed.

Level 2. Technical Data Review

A supervisor or data review specialist whose function is to provide an independent review of data packages will perform this review. This review will also be conducted according to an established set of guidelines and will be structured to verify the following finding of Level 1 data review:

- All appropriate laboratory SOPs have been followed
- Calibration data are scientifically sound, appropriate to the method, and completely documented

- QC samples are within established guidelines
- Qualitative identification of contaminants is correct
- Manual integrations are justified and properly documented
- Quantitative results and calculations are correct
- Data are qualified correctly
- Documentation is complete, for example, any anomalies and holding times have been documented and appropriate forms have been completed
- Data are ready for incorporation into the final report
- The data package is complete and complies with contract requirements

The Level 2 review will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10 percent of the samples are checked back to the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If any problems are found with the data package, an additional 10 percent of the sample results will be checked back to the sample preparatory and analytical bench sheets. This cycle will then be repeated either until no errors are found in the checked data set or until all data has been checked. All errors and corrections noted will be documented.

Level 3. Administrative Quality Assurance Data Review

The Laboratory QA Manager will review 10 percent of all data packages. This review should be similar to the review as provided in Level 2, except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. All errors noted will be corrected and documented.

14.6 Data Reporting and Laboratory Hard Copy Deliverables

All relevant raw data and documentation, including (but not limited to) logbooks, data sheets, electronic files, and final reports, will be maintained by the laboratory for at least 10 years. The laboratory will notify Shaw 30 days before disposal of any relevant laboratory records.

The hard copy data deliverable requirements for this project will be:

- VOCs analysis groundwater samples: 90 percent Level III and 10 percent Level IV
- Dissolved gases analysis groundwater samples: 100 percent Level III
- VOC analysis soil samples: 100 percent Level III

- Waste samples: 100 percent Level II

The laboratory will qualify data according to requirements established in the DoD QSM (2010) Section 5.10 for reporting data.

14.6.1 Electronic Deliverables

The EDD will be in EnviroData format (or equivalent). The analytical laboratory will follow the requirements stated in the Laboratory Interface Document for the Analytical Laboratory EDD. Within 30 days after the internal review of analytical results, per the requirements of *Environmental Work Instruction EVR.6 – Environmental Data Management and Required Electronic Delivery Standards* (NAVFAC SW, 2005), Shaw E&I will submit analytical data to the Naval Installation Restoration Information Solutions (NIRIS) in the Naval EDD format. All data collected for this project (except waste data) will be uploaded to NIRIS.

The laboratory will certify that the EDD and the hard copy reports are identical. Both the EDD and the hard copy will present results to two or three significant figures. Field information (e.g., date and time collected, sample identification, etc.) will be entered directly into the main database from the chain-of-custody record or uploaded from electronic files generated in the field.

14.7 DATA VALIDATION

Data validation will be performed by an independent third party data validation company on VOC analysis only. The analytical data for dissolved gas analysis will be reviewed by a project chemist (Section 14.7.2). The data validation will be in compliance with the following guidance: DoD QSM (2010); *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, EPA 540/R-08-01* (EPA, 2008); and the QC criteria specified in this SAP. Data will be flagged with the following data qualifiers:

- ***J qualifier*** denotes the analyte was positively identified, but the associated numerical value is estimated.
- ***R qualifier*** denotes the data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
- ***U qualifier*** denotes the analyte was analyzed for, but not detected. The associated numerical value is at or below the reporting limit.
- ***UJ qualifier*** denotes the analyte was analyzed for, but not detected. There is uncertainty associated with the reporting limit.

14.7.1 Level III and Level IV Data Validation

Data validation requirements will follow the guidelines established in *Environmental Work Instruction 3EN2.1 – Chemical Data Validation* (NAVFAC SW, 2001). This subsection briefly describes what is reviewed for each validation level.

For a Level III data validation effort, the data values for routine and QC samples are generally assumed to be correctly reported by the laboratory. Data quality is assessed by comparing the parameters listed below to the appropriate criteria (or limits) as specified in the SAP, the DoD QSM (2010), or by EPA method-specific requirements. If calculations for quantitation are verified, it is done on a limited basis and may require raw data in addition to the standard data forms normally present in a data package.

Level III data review may include the following QC elements (depending on the analysis being reviewed):

- Sample receipt and preservation
- Sample holding times
- Laboratory method blanks
- Surrogate recoveries
- Internal standards
- Laboratory control sample/laboratory control duplicate (LCS/LCD)
- Matrix spike/matrix spike duplicate (MS/MSD) recoveries
- RPD
- Initial calibration (ICAL)
- Continuing calibration verification (CCV)
- Retention time evaluation (gas chromatograph [GC] methods)
- Field blanks
- Field duplicate

Level IV validation includes all of the above and the following QC elements:

- Instrument tuning and system performance (gas chromatograph/mass spectrometer [GC/MS])
- Analyte identification (e.g., spectra and chromatograms)
- Analyte quantitation (calculation check)

14.7.2 Data Review

A Shaw project chemist will review the data collected for dissolved gas analyses to determine if basic QC criteria have been met and to establish data usability. The following QC elements will be review:

- Sample receipt
- Sample holding times
- Laboratory method blanks
- Laboratory control sample/laboratory control duplicate (LCS/LCD)
- LCS/LCD RPD
- Initial calibration (ICAL)
- Continuing calibration verification (CCV)

SAP Worksheet #15.1—Reference Limits and Evaluation Table—Volatile Organic Compounds (Water)

Analyte	CAS Number	Project Cleanup Standards (µg/L) ¹	Project Cleanup Standards Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)	
					LOQ	LOD
Site-Specific VOCs						
Tetrachloroethene	127-18-4	5	MCL	1	0.5	0.2
Trichloroethene	79-01-6	5	ROD and ESD cleanup standard (EPA, 1989 and 1990)	1	0.5	0.2
cis-1,2-Dichloroethene	156-59-2	6	MCL	1	0.5	0.2
trans-1,2-Dichloroethene	156-60-5	6	MCL	1	0.5	0.2
1,1-Dichloroethene	75-35-4	6	MCL	1	0.5	0.2
Vinyl Chloride	75-01-4	0.5	MCL	0.5	0.5	0.2
1,1-Dichloroethane	75-34-3	5	MCL	1	0.5	0.2
Other VOCs						
Acetone	67-64-1	None	Not applicable	50	5	5
Benzene	74-43-2	None	Not applicable	1	0.5	0.1
Bromobenzene	108-86-1	None	Not applicable	1	0.5	0.2
Bromodichloromethane	75-27-4	None	Not applicable	1	0.5	0.4
Bromoform	75-25-2	None	Not applicable	1	0.5	0.2
Bromomethane	74-83-9	None	Not applicable	1	1	0.4
2-Butanone	78-93-3	None	Not applicable	50	10	2
n-Butylbenzene	104-51-8	None	Not applicable	1	0.5	0.4
sec-Butylbenzene	135-98-8	None	Not applicable	1	0.5	0.4
tert-Butylbenzene	98-06-6	None	Not applicable	1	0.5	0.4
Carbon Disulfide	75-15-0	None	Not applicable	1	0.5	0.2
Carbon Tetrachloride	56-23-5	None	Not applicable	1	0.5	0.2
Chlorobenzene	108-90-7	None	Not applicable	1	0.5	0.2
Dibromochloromethane	124-48-1	None	Not applicable	1	0.5	0.2
Chloroethane	75-00-3	None	Not applicable	5	1	0.4
Chloroform	67-66-3	100	MCL	1	0.5	0.2
Chloromethane	74-87-3	None	Not applicable	5	1	0.4
1,2-Dibromo-3-Chloropropane	96-12-8	None	Not applicable	1	2	1
2-Chlorotoluene	95-49-8	None	Not applicable	1	0.5	0.2
2-Chlorotoluene	95-49-8	None	Not applicable	1	0.5	0.2
1,2-Dibromoethane (EDB)	106-93-4	None	Not applicable	1	0.5	0.2

SAP Worksheet #15.1—Reference Limits and Evaluation Table—Volatile Organic Compounds (Water) (continued)

Analyte	CAS Number	Project Cleanup Standards (µg/L) ¹	Project Cleanup Standards Reference	Project Quantitation Limit Goal (µg/L)	Laboratory-Specific (µg/L)	
					LOQ	LOD
1,2-Dichlorobenzene	95-50-1	600	MCL	1	0.5	0.2
1,3-Dichlorobenzene	541-73-1	None	Not applicable	1	0.5	0.2
1,4-Dichlorobenzene	106-46-7	None	Not applicable	1	0.5	0.2
1,2-Dichloroethane	107-06-2	None	Not applicable	1	0.5	0.2
1,2-Dichloropropane	78-87-5	None	Not applicable	1	0.5	0.2
1,3-Dichloropropane	142-28-9	None	Not applicable	1	0.5	0.2
Ethyl benzene	100-41-4	None	Not applicable	1	0.5	0.2
Hexachlorobutadiene	87-68-3	None	Not applicable	5	2	0.5
Isopropylbenzene	98-82-8	None	Not applicable	1	0.5	0.2
Methylene Chloride	75-09-2	None	Not applicable	5	5	1
Methyl isobutyl ketone	108-10-1	None	Not applicable	50	10	2
Methyl tertiary butyl ether	1634-04-4	None	Not applicable	1	0.5	0.2
Naphthalene	91-20-3	None	Not applicable	10	2	1
n-Propylbenzene	106-65-1	None	Not applicable	1	0.5	0.2
Styrene	100-42-5	None	Not applicable	1	0.5	0.2
1,1,1,2-Tetrachloroethane	630-20-6	None	Not applicable	1	0.5	0.2
1,1,2,2-Tetrachloroethane	79-34-5	None	Not applicable	1	0.5	0.2
Toluene	108-88-3	None	Not applicable	1	0.5	0.1
1,2,4-Trichlorobenzene	120-82-1	None	Not applicable	1	0.5	0.2
1,1,1-Trichloroethane	71-55-6	200	MCL	1	0.5	0.2
1,1,2-Trichloroethane	79-00-5	None	Not applicable	1	0.5	0.2
Trichlorofluoromethane	75-69-4	None	Not applicable	1	1	0.4
1,2,3-Trichloropropane	96-18-4	None	Not applicable	1	0.5	0.4
1,2,4-Trimethylbenzene	95-63-6	None	Not applicable	1	0.5	0.2
1,3,5-Trimethylbenzene	108-67-8	None	Not applicable	1	0.5	0.2
Xylene (Total)	1330-20-7	None	Not applicable	2	0.5	0.2

Notes:

¹The EPA's September 1990 ESD to the ROD (EPA, 1989) selected TCE as an indicator chemical for remediation purposes and set the final cleanup standard at 5 µg/L, no other cleanup standards were specified. The ROD also states that the federal and State of California drinking water standards are chemical-specific applicable and relevant and appropriate requirements that are relevant and appropriate at the site (i.e., MCLs) for the other chemicals of concern.

CAS

Chemical Abstracts Service

LOD

limit of detection

SAP Worksheet #15.2—Reference Limits and Evaluation Table—Volatile Organic Compounds (Soil Matrix)

Analyte	CAS Number	Units	Project Cleanup Standards ¹	Project Cleanup Standards Reference ¹	Project Quantitation Limit Goal	Laboratory-Specific	
						LOQs	DLs
Acetone	67-64-1	mg/kg	None	Not applicable	0.010	0.010	0.005
Benzene	74-43-2	mg/kg	None	Not applicable	0.005	0.005	0.002
Bromobenzene	108-86-1	mg/kg	None	Not applicable	0.005	0.005	0.002
Bromodichloromethane	75-27-4	mg/kg	None	Not applicable	0.005	0.005	0.002
Bromoform	75-25-2	mg/kg	None	Not applicable	0.005	0.005	0.002
Bromomethane	74-83-9	mg/kg	None	Not applicable	0.010	0.010	0.005
2-Butanone	78-93-3	mg/kg	None	Not applicable	0.010	0.010	0.005
n-Butylbenzene	104-51-8	mg/kg	None	Not applicable	0.005	0.005	0.002
sec-Butylbenzene	135-98-8	mg/kg	None	Not applicable	0.005	0.005	0.002
tert-Butylbenzene	98-06-6	mg/kg	None	Not applicable	0.005	0.005	0.002
Carbon Disulfide	75-15-0	mg/kg	None	Not applicable	0.005	0.005	0.002
Carbon Tetrachloride	56-23-5	mg/kg	None	Not applicable	0.005	0.005	0.002
Chlorobenzene	108-90-7	mg/kg	None	Not applicable	0.005	0.005	0.002
Dibromochloromethane	124-48-1	mg/kg	None	Not applicable	0.005	0.005	0.002
Chloroethane	75-00-3	mg/kg	None	Not applicable	0.005	0.005	0.002
Chloroform	67-66-3	mg/kg	None	Not applicable	0.005	0.005	0.002
Chloromethane	74-87-3	mg/kg	None	Not applicable	0.010	0.010	0.005
4-Chlorotoluene	106-43-4	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2-Dibromo-3-Chloropropane	96-12-8	mg/kg	None	Not applicable	0.005	0.005	0.002
2-Chlorotoluene	95-49-8	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2-Dibromoethane (EDB)	106-93-4	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2-Dichlorobenzene	95-50-1	mg/kg	None	Not applicable	0.005	0.005	0.002
1,3-Dichlorobenzene	541-73-1	mg/kg	None	Not applicable	0.005	0.005	0.002
1,4-Dichlorobenzene	106-46-7	mg/kg	None	Not applicable	0.005	0.005	0.002
Dichlorodifluoromethane	75-71-8	mg/kg	None	Not applicable	0.010	0.010	0.005
1,1-Dichloroethane	75-34-3	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2-Dichloroethane	107-06-2	mg/kg	None	Not applicable	0.005	0.005	0.002
1,1-Dichloroethene	75-35-4	mg/kg	None	Not applicable	0.005	0.005	0.002
cis-1,2-Dichloroethene	156-59-2	mg/kg	None	Not applicable	0.005	0.005	0.002
trans-1,2-Dichloroethene	156-60-5	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2-Dichloropropane	78-87-5	mg/kg	None	Not applicable	0.005	0.005	0.002
1,3-Dichloropropane	142-28-9	mg/kg	None	Not applicable	0.005	0.005	0.002
Ethyl benzene	100-41-4	mg/kg	None	Not applicable	0.005	0.005	0.002

SAP Worksheet #15.2—Reference Limits and Evaluation Table—Volatile Organic Compounds (Soil Matrix) (continued)

Analyte	CAS Number	Units	Project Cleanup Standards ¹	Project Cleanup Standards Reference ¹	Project Quantitation Limit Goal	Laboratory-Specific	
						LOQs	DLs
Hexachlorobutadiene	87-68-3	mg/kg	None	Not applicable	0.005	0.005	0.002
Isopropylbenzene	98-82-8	mg/kg	None	Not applicable	0.005	0.005	0.002
Methylene Chloride	75-09-2	mg/kg	None	Not applicable	0.010	0.010	0.002
Methyl isobutyl ketone (MIBK)	108-10-1	mg/kg	None	Not applicable	0.010	0.010	0.005
Methyl tertiary butyl ether (MTBE)	1634-04-4	mg/kg	None	Not applicable	0.005	0.005	0.002
Naphthalene	91-20-3	mg/kg	None	Not applicable	0.005	0.005	0.002
n-Propylbenzene	106-65-1	mg/kg	None	Not applicable	0.005	0.005	0.002
Styrene	100-42-5	mg/kg	None	Not applicable	0.005	0.005	0.002
1,1,1,2-Tetrachloroethane	630-20-6	mg/kg	None	Not applicable	0.005	0.005	0.002
1,1,2,2-Tetrachloroethane	79-34-5	mg/kg	None	Not applicable	0.005	0.005	0.002
Tetrachloroethene	127-18-4	mg/kg	None	Not applicable	0.005	0.005	0.002
Toluene	108-88-3	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2,4-Trichlorobenzene	120-82-1	mg/kg	None	Not applicable	0.005	0.005	0.002
1,1,1-Trichloroethane	71-55-6	mg/kg	None	Not applicable	0.005	0.005	0.002
1,1,2-Trichloroethane	79-00-5	mg/kg	None	Not applicable	0.005	0.005	0.002
Trichloroethene	79-01-6	mg/kg	None	Not applicable	0.005	0.005	0.002
Trichlorofluoromethane	75-69-4	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2,3-Trichloropropane	96-18-4	mg/kg	None	Not applicable	0.005	0.005	0.002
1,2,4-Trimethylbenzene	95-63-6	mg/kg	None	Not applicable	0.005	0.005	0.002
1,3,5-Trimethylbenzene	108-67-8	mg/kg	None	Not applicable	0.005	0.005	0.002
Vinyl Chloride	75-01-4	mg/kg	None	Not applicable	0.005	0.005	0.002
Xylene (Total)	1330-20-7	mg/kg	None	Not applicable	0.010	0.010	0.002

Notes:

¹ There are no project action levels for VOCs in soil. The VOC soil analysis is performed to identify possible DNAPL source areas. The quantitation limit goals and laboratory LOQs are sufficient to meet the needs for the intended use of this data.

CAS Chemical Abstracts Service
 DL detection limit
 mg/kg milligram per kilogram

SAP Worksheet #15.3—Reference Limits and Evaluation Table—Dissolved Gasses (Water)

Analyte	CAS Number	Units	Project Limit ¹	Project Limit Reference	Project Quantitation Limit Goal	Laboratory-Specific	
						LOQs	MDLs
Methane	74-82-8	µg/L	None	Not applicable	0.1	0.1	0.024
Ethane	74-84-0	µg/L	None	Not applicable	0.025	0.025	0.002
Ethene	74-85-1	µg/L	None	Not applicable	0.025	0.025	0.008
Acetylene	74-86-2	µg/L	None	Not applicable	0.5	0.5	0.04

Notes:

¹ No Action Limits for these parameters. Data collected to monitor abiotic and biotic breakdown of CEs.

CAS Chemical Abstracts Service
 MDL method detection limit

SAP Worksheet #16—Project Schedule/Timeline Table

Activity	2012												2013												2014		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
Plans					█																						
Regulatory Review of DRAFT Plans					█																						
Respond to Comments and Prepare FINAL Plans						█	█																				
Field Work									█																		
SCAPS Survey									█	█																	
Develop Phase II Plan										█	█																
Present & Refine Phase II Plan w/ Agencies											█																
Install Monitoring Wells												█	█														
Well Sampling - 1st Event													█														
Well Sampling - 2nd Event														█													
Reporting & Data Submission																	█										
Prepare DRAFT Technical Memorandum																	█	█	█								
Regulatory Review of DRAFT Tech Memo																						█					
Respond to Comments and Prepare FINAL Tech Memo																							█	█			

SAP Worksheet #17—Sampling Design and Rationale

This supplemental investigation will be completed in two phases: a preliminary screening survey (Phase I) followed by installing groundwater monitoring wells and groundwater sampling (Phase II). The investigation activities will be conducted at the Former Building 88 and Traffic Island Areas (Figures A2 and A3). Phase I will be completed to further refine the understanding of the distribution of CEs and soil lithology in the investigation areas. Results from this first phase of work, along with existing data, will be used to identify the location and properly design new wells to be installed during Phase II. Once the new wells are constructed, groundwater samples will be collected from the wells during two separate sampling events. The following sections summarize the general approach for the supplemental investigation.

17.1 TRIAD APPROACH

The investigation will be implemented using the EPA's Triad approach (2001b) in coordination with the Navy, EPA, and Water Board. The Triad approach embraces scientific and process improvements in three areas: systematic project planning, dynamic work strategies, and real-time measurement technologies (Interstate Technology & Regulatory Council, 2003). The use of the Triad approach will accomplish the following objectives:

- To reduce uncertainties in the CSM by further characterizing the lateral and vertical extent of PCE and its daughter products (TCE, cis 1,2 DCE, and VC) and the soil stratigraphy in the saturated zone at the former Building 88 and Traffic Island source areas in order to support decisions for locating and designing new groundwater monitoring wells, and for source area remediation in the future
- To increase communication and consensus between project decision makers with regard to project constraints, decisions, and the accepted level of uncertainty in the project data and analyses
- To use real-time methods to quickly provide data to the Triad team that can be used collaboratively to analyze samples and evaluate the data in order to adjust the locations of subsequent samples, thus reducing uncertainty through the acquisition of a larger quantity of optimal data without a significant increase in project duration and cost

During the course of the fieldwork, Shaw E&I will prepare reports that briefly summarize field activities, present current data, and document field decisions. The reports will be delivered electronically to the Triad team on a weekly basis to allow team members to follow the investigation and to provide input to the dynamic investigation process. Additionally, the Triad team will meet between Phase I and Phase II to discuss and finalize well location and design.

17.2 PHASE I—PRELIMINARY SCREENING SURVEY

The Phase I screening survey will be performed using use the Navy's SCAPS MIP/DSITMS and CPT equipment to provide a vertical profile of the distribution of chemicals of concern and soil lithology in the subsurface at each investigation area.

The MIP is a qualitative to semi-quantitative screening device used to rapidly generate a real time log of the relative concentration of VOCs in the subsurface at multiple depths within a single penetration. It is used in conjunction with a direct push platform to drive the MIP to discrete depth(s) of interest to collect samples of vaporized compounds for real time measurement at the surface (EPA, 2012). For this investigation, the MIP will be driven into the subsurface by the Navy's SCAPS rig, which is a direct push platform that uses a hydraulic ram to advance (push) various sampling and in situ measuring devices into the ground.

The MIP data is considered qualitative to semi-quantitative due to inherent in-situ sampling limitations and possible matrix effects. The MIP is a bulk matrix sampling device used to vaporize VOCs from both soil and groundwater simultaneously and can be subject to variations in system response due to grain size changes within the soil matrix. For example, VOC measurements tend to be biased high in fine grained sediments such as silts and clays. Additionally, the MIP samples VOCs in direct contact with its heated membrane surface but the sample size or area influenced by the heated membrane is uncertain. Because the mass and volume of the sampled matrix are not known, the MIP data are only considered to be estimates (U.S. Army Corps of Engineers, 2002). The results produced by a MIP at any location are relative and should be compared to soil and groundwater analytical data for a better understanding of the results (EPA, 2012). Therefore, several of the MIP tests are planned at locations adjacent to previous MIP borings, discrete-depth groundwater samples, and groundwater monitoring wells that were not affected by the 2010 – 2011 treatability study. This allows the new MIP results to be compared relative to previous MIP results and groundwater results produced by more conventional sampling and analytical methods. A qualitative comparison between the new MIP data and the previous MIP data will be performed to evaluate the correlation between the two data sets. The new MIP data will also be compared with the discrete-depth groundwater data and well groundwater data through straightforward linear regression analyses.

The MIP tool consists of a thin polymer (tetrafluoroethene) membrane that is permeable to gas but impermeable to liquids. The membrane is impregnated into a small stainless steel screen mounted to a heated block that is attached to a direct-push probe. The screen is mounted flush to the exterior surface of the probe to allow direct contact with the subsurface (soil and groundwater). The block is heated to between 100 and 120 °C to accelerate the diffusion of VOCs in the soil and groundwater across the membrane into a tube where clean helium carrier gas conveys the liberated VOCs to an analytical device at the surface.

For this investigation, a DSITMS will be used as the analytical device to identify and quantify the specific VOCs in $\mu\text{g/L}$ of MIP calibration solution by EPA Method 8265 rather than using the ECD, PID and FID detectors, which do not speciate the detected compounds. Speciation of the detected compounds for this effort will be useful to further define the extent of the Navy's source area within the regional plume and for attempting to differentiate between contaminants from the Navy's source area and those migrating on site from upgradient sources. Initially, the DSITMS will be calibrated for the target VOCs (i.e., PCE, TCE, 1,2-DCE, and VC); although, the DSITMS will indicate the presence or absence of non-target VOCs. If non-target VOCs are detected, the DSITMS can be calibrated for the additional compounds. Although it is variable, the MIP/DSITMS screening sensitivity is expected to range between approximately 500 and 1,000 $\mu\text{g/L}$ of calibration solution for each target compound. In addition to semi-quantitative measurements at prescribed sampling depths, the DSITMS is also capable of continuous (lower sensitivity) VOC monitoring as the MIP is advanced between discrete sampling depths allowing identification of intervals with high concentrations of VOCs that could also be targeted for discrete-depth measurements. Only the higher sensitivity data from the discrete-depth samples will be recorded,

In addition to the VOC measurements, continuous lithologic data will also be collected during each of the MIP penetrations to correlate contaminant distribution with soil lithology and to further characterize the lateral and vertical extent of significant stratigraphic features such as paleochannels and low permeability units that may affect the distribution and migration of the target VOCs (i.e., A/B-Aquitard, paleochannel deposits, etc.). To continuously log lithologic data, the SCAPS MIP tool is outfitted with CPT piezo elements to measure resistance to penetration as the tool is advanced in the subsurface. Cone resistance and sleeve friction are measured simultaneously in units of tons per square foot. The ratio of sleeve friction to cone resistance combined with the cone resistance value correspond to soil behavior classifications using Robertson and Campanella's method (1988). The CPT measurements will be relatively continuous at a resolution of approximately one reading per every 1-inch interval. The SCAPS equipment provides an on-board, real-time display of CPT data, including the inferred soil classification, which will be useful for targeting specific intervals to collect MIP/DSITMS measurements. Several of the SCAPS CPT/MIP tests are planned at locations adjacent to previous MIP borings, a CPT boring, a continuous soil core, and groundwater monitoring wells, so the new CPT lithologic logs can be qualitatively compared to previous manually logged boreholes, CPT lithologic logs, and MIP soil electrical conductivity logs. The lithologic data from the CPT will be integrated with the MIP/DSITMS data to both refine the CSM and support placing and designing the planned monitoring wells.

Each area will have a set of designated locations to initiate the SCAPS survey; identified as Tier 1 test locations. Based on the real-time data and the evolving CSM, additional stepout/step-in

(Tier 2) locations may be completed. The step-out/step-in sampling will occur after the Tier 1 tests have been completed. A review of the results for the Tier 1 tests along with previously collected data will be performed to identify potential locations for the Tier 2 tests. A Triad meeting will be held to review, refine, and mutually agree on the Tier 2 test locations.

Individual SCAPS profile depths will vary by location, but the maximum depth is expected to be approximately 100 feet bgs, which is also the maximum depth the SCAPS CPT/MIP can achieve due to a limited cable length. Actual borehole depths may also be limited by penetration refusal due to dense or cemented soil.

17.3 PHASE II—MONITORING WELL INSTALLATION AND SOIL AND GROUNDWATER SAMPLING

Upon completion of Phase I activities, the SCAPS and previous site investigation data will be evaluated to determine the locations and screen intervals for new monitoring wells. The proposed locations and screen intervals will be presented to the Triad team before installing the new wells. Up to 12 new monitoring wells are planned to be installed in the A-Aquifer and B-Aquifer to a maximum depth ranging from 65 feet bgs at the Former Building 88 Area to 95 feet bgs at the Traffic Island Area. New wells are tentatively planned for the following locations at the Former Building 88 Area:

- Within the upper portion of the A-Aquifer in the area of the equipment room of former Building 88, to further define and monitor concentrations of CEs in groundwater where historical MIP data (Shaw E&I, 2010) and discrete soil data (TtECI, 2008) have indicated elevated concentrations of residual CEs persist
- Within the upper and lower portions of the A-Aquifer immediately downgradient of the equipment room of former Building 88 near existing wells 28OW-19 and 28OW-20, to further define and monitor concentrations of CEs in groundwater immediately downgradient of where historical MIP data (Shaw E&I, 2010) and discrete soil data (TtECI, 2008) have indicated elevated concentrations of residual CEs persist
- Within the upper and lower portions of the A-Aquifer upgradient of the former Building 88 source area, outside the area where data indicate elevated concentrations of residual CEs persist, to further define and monitor the on flow of CEs from upgradient regional contaminant sources

At the Traffic Island Area, new wells are tentatively planned for the following locations:

- Within the lower portion of the A-Aquifer, immediately above the A/B-Aquitard (approximately 55 to 65 feet bgs), upgradient of the EVO pilot test area near existing wells 28OW-09, 28OW-10, and 28OW-11 to further define and monitor the on flow of CEs from upgradient regional contaminant sources

- Within the B2-Aquifer, upgradient and downgradient of existing well W88-1, to define the lateral extent of CEs in the B2-Aquifer beneath the Traffic Island Area
- Within the silty sand between 87 and 90 feet bgs, below existing well W88-1, to define the vertical extent of CEs beneath the Traffic Island Area

Sonic drilling techniques will be used to complete each borehole and to install the monitoring wells. Before constructing each well, continuous soil cores will be collected from each well borehole to visually log the soil and collect discrete depth soil samples for fixed-base laboratory analysis of VOCs by EPA Method 8260. The samples will be collected from the depth of the highest CE concentration as indicated by nearby MIP tests and as measured with field instruments (i.e., PID) while logging the soil core. If indications of DNAPL are indicated by nearby MIP tests (response greater than 50,000 $\mu\text{g/L}$ of calibration solution) or observed when logging the soil core (i.e. visually or by field PID screening measurements), then select soil sample aliquots will be field screened using an OilScreenSoil (Sudan IV)[®] field screening kit, which uses a hydrophobic dye to produce a qualitative colorimetric response to indicate the presence of DNAPL in soils. Following construction, the wells will be developed by surging and bailing and then sampled during two separate groundwater sampling events that are a minimum of three months apart. The groundwater samples will be collected using low-flow purging and sampling techniques, and then analyzed for VOCs and dissolved gases.

17.4 WASTE SOIL AND WASTEWATER SAMPLING

Waste soil generated from the well installation will be consolidated into one waste stream and will be characterized for off-site disposal.

- Waste soil samples will be analyzed for VOCs by EPA 8260B.

No samples of the wastewater will be collected because the wastewater generated from site activities will be treated by WATS. No off-site disposal for wastewater is planned.

SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table

Sampling Location	Sample ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples	Sampling SOP Reference
SCAPS MIP/DSITMS Location (Tier 1)	SCAPS-01 through SCAPS-28	Bulk Soil and Groundwater	5 – 100 (maximum depth)	VOCs	Up to 800 (estimated screening every 3 feet)	SAP WS #14
SCAPS MIP/DSITMS Location (Tier 2)	SCAPS-29 through SCAPS-52	Bulk Soil and Groundwater	5 – 100 (maximum depth)	VOCs	Up to 780 (estimated screening every 3 feet)	SAP WS #14
New Well Installation	W28-01-Depth W28-02-Depth W28-03-Depth W28-04-Depth W28-05-Depth W28-06-Depth W28-07-Depth W28-08-Depth W28-09-Depth W28-10-Depth W28-11-Depth W28-12-Depth	Soil	Sample depth determined based on SCAPS (Phase I) results and field PID screening of soil core (Phase II)	VOCs	Up to 29 total samples	SAP WS #14
New Wells Initial Sampling Event	W28-01-Date W28-02-Date W28-03-Date W28-04-Date W28-05-Date W28-06-Date W28-07-Date W28-08-Date W28-09-Date W28-10-Date	Groundwater	Well construction details (screen intervals) will be based on SCAPS (Phase I) results	VOCs Dissolved Gases	12	SAP WS #14

SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location	Sample ID Number	Matrix	Depth (feet bgs)	Analytical Group	Number of Samples	Sampling SOP Reference
New Wells Initial Sampling Event (continued)	W28-11-Date W28-12-Date					
New Wells Second Sampling Event	W28-01-Date W28-02-Date W28-03-Date W28-04-Date W28-05-Date W28-06-Date W28-07-Date W28-08-Date W28-09-Date W28-10-Date W28-11-Date W28-12-Date	Groundwater	Well construction details (screen intervals) will be based on SCAPS (Phase I) results	VOCs Dissolved Gases	12	SAP WS #14
Waste soil	WS-001	Soil	not applicable	VOCs	As needed	SAP WS #14

SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Sample Volume	Container	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/analysis)
Soil	VOCs	Preparation: EPA 5035 Analysis: EPA 8260B SOP# VOCs by GC/MS-2.4	about 5 grams	Three En Core® devices	Cool at 4±2°C	48 hours until preservation at the lab 14 days after preservation
Water	VOCs	Preparation: EPA 5030B Analysis: EPA 8260B SOP# VOCs by GC/MS-2.4	40 mL	Three × 40-mL vials, Teflon™-lined septum	hydrochloric acid (HCl) to pH less than (<) 2, Cool at 4±2°C	14 days
Water	Dissolved gasses	Preparation and Analysis: Microseeps AM20GAX SOP# AM20GAX	40 mL	Two 40-mL vials with Butyl rubber septa	trisodium phosphate (Na ₃ PO ₄), Cool at 4±2°C	14 days

SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	# of Primary Sampling Locations	# of Field Duplicates	# of MS/MSDs	# of Field Blanks	# of Equipment Rinse Blanks	# of Trip Blanks	Total # of Samples to Laboratory
Soil	VOCs	Up to 29	None	None	None	None	None	29
Groundwater	VOCs Dissolved gasses	12 per event (24 total)	2	2 (VOCs only)	None	4 (estimated)	4 (estimated)	36
Waste Soil	VOCs	1	None	None	None	None	None	1

SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title	Date, Revision and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SAP WS# 14	Soil Sampling During Well Installation	Not Applicable	Shaw E&I	Sonic Rig	N	None
SAP WS# 14	Groundwater Sampling	Not Applicable	Shaw E&I	Bladder Pump	N	None
SAP WS# 14	En Core® Sampler	Not Applicable	Shaw E&I	En Core®	N	None

SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Standard Operating Procedure Reference
SCAPS MIP/DSITMS	Calibration check standard	Daily before use and minimum of once after each penetration is completed	Calibration Factor % percent difference < 50% from ICAL	Perform system leak check; evaluate calibration standard against second source standard; or repair and recalibrate if needed	SCAPS operator	SOP for the Analysis of VOCs from MIP with DSITMS, Rev 1.3
PID	Isobutylene Standard (100 ppm in air)	Start of working day	± 20% of the standard value	Recalibrate	Field Sample Technician or H&S Officer	Manufacturer Operation Manual
Water Quality meter	ORP	Start of working day	± 15% of the standard value	Recalibrate	Field Sample Technician or Project Chemist	Manufacturer Operation Manual
	DO (ambient air)	Start of working day	± 20% of 100% Saturation	Recalibrate	Field Sample Technician or Project Chemist	Manufacturer Operation Manual
	pH (4.0 or 7.0) standard	Start of working day	± 0.5 pH unit of the standard value	Recalibrate	Field Sample Technician or Project Chemist	Manufacturer Operation Manual
	Specific Conductance Standard	Start of working day	± 15% of the standard value	Recalibrate	Field Sample Technician or Project Chemist	Manufacturer Operation Manual

Note:

ppm

part per million

SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
AM20GAX	GC dissolved gasses chromatography	Screening	Water-Dissolved gasses	GC Flame Ionization Detector Thermal Conductivity Detector	Microseeps	N
C&T—2.4 ¹	Volatile Organics by GC/MS, Rev. 10 3/21/2011	Definitive	Soil and Water-VOCs	GC/MS	C&T	N

Note:

¹ Laboratory SOPs will be provided in the electronic copy of the Final SAP (Attachment 2)

SAP Worksheet #24—Analytical Instrument Calibration Table (Gas Chromatograph/Mass Spectrometer Volatile Organic Compounds)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS Volatile Organic Analysis (8260B)	Check of mass spectral ion intensities (tuning procedure) using bromofluorobenzene	Prior to ICAL and calibration verification	Must meet the EPA method requirements before samples are analyzed m/z Required Intensity (relative abundance) mass 50 to 15 to 40% of m/z 95 mass 75 to 30 to 60% of m/z 95 mass 95 to base peak, 100% relative abundance mass 96 to 5 to 9% of m/z 95 mass 173 < 2% of m/z 174 mass 174 greater than (>) 50% of m/z 95 mass 175 to 5 to 9% of m/z 174 mass 176 > 95% but < 101% of m/z 174 mass 177 to 5 to 9% of m/z 176	If necessary, Perform maintenance such as clean/change injection port, clip column, clean detector, etc. and Retune instrument and verify the tune acceptability	C&T Chemist	C&T—2.4
	Five-point ICAL for target analytes, lowest standard at or near the LOQ	ICAL prior to sample analysis	The minimum average system performance check compound response factor is 0.1 for chloromethane, 1,1-dichloroethane, and bromoform and 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane	If necessary, Perform maintenance and Retune instrument and verify the tune acceptability, then repeat ICAL	C&T Chemist	
	Second-source calibration verification	Once per five-point ICAL	< 20% difference for all target analytes and calibration check compounds	First, reanalyze second source standard. If necessary, perform preventative maintenance. Then repeat ICAL	C&T Chemist	

SAP Worksheet #24—Analytical Instrument Calibration Table (Gas Chromatograph/Mass Spectrometer Volatile Organic Compounds) (continued)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/MS Volatile Organic Analysis (8260B) (continued)	Daily calibration verification	Before sample analysis and every 12 hours of analysis time	Average response factors for system performance check compounds greater than or equal to (\geq) 0.30 for Chlorobenzene & 1,1,2,2 TCA; \geq 0.1 for chloromethane, bromoform and 1,1-dichloroethane Less than or equal to 20% difference for all target analytes and calibration check compounds	If necessary, perform maintenance such as clean/change injection port, clip column, clean detector, etc. Then repeat ICAL Reanalyze samples with non-compliant bracketing CCVs	C&T Chemist	C&T—2.4
	Internal standards	During acquisition of calibration standard	Areas within -50% to +100% of ICAL midpoint standard.	Inspect GC/MS for malfunctions; determine if internal standard failure was due to sample matrix or instrument malfunction. If necessary re-extract and reanalyze samples with non-compliant Internal standards	C&T Chemist	

Note:

m/z

mass to charge ratio

SAP Worksheet #24.1 – Analytical Instrument Calibration Table (Gas Chromatography)

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action	Person(s) Responsible for Corrective Actions	SOP Reference
GC/Flame Ionization Detector (FID) Thermal conductivity detector (TCD)	Minimum five-point initial calibration for target analytes, lowest concentration standard at or near the reporting limit.	Initial calibration prior to sample analysis	One of the options below: <u>Option 1:</u> relative standard deviation (RSD) for each analyte $\leq 20\%$; <u>Option 2:</u> linear least squares regression: $r \geq 0.995$;	Repeat analysis of concentrations not meeting acceptance criteria If necessary: Perform instrument maintenance (such as clean/change injection port, clip column, clean detector, etc); then repeat initial calibration.	Lab Manager / Analyst	AM20GAX
GC/FID/TCD	Second-source initial calibration verification.	Once per initial calibration	Less than 20% difference for target analytes.	If necessary: Perform instrument maintenance then repeat initial calibration.	Lab Manager / Analyst	
GC/FID/TCD	Daily continuing calibration verification (CCV)	Before sample analysis and every 15 samples throughout the day and at the end of the the analysis sequence	Control limit: 85% - 115% of true concentrations	If necessary: Perform instrument maintenance; then repeat initial or daily calibration; reanalyze samples with non-compliant bracketing CCVs	Lab Manager / Analyst	

SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS GC-FID/TCD	Injection port Maintenance	Preventative maintenance	Change septum, clean injection port, clip column	Daily	Tune and CCV pass criteria (WS #24)	Reinspect injector port, cut additional column, reanalyze CCV, recalibrate instrument	Analyst/Department Manager	2.4 MS VOA AM20Gax
GC/MS	Trap	CCV response dropping, sample foamed over	Change trap	When responses start to drop or after foam over samples	Tune and CCV passes criteria. (WS #24)	Rebake trap, replace trap, reanalyze CCV, recalibrate	Analyst/Department Manager	2.4 MS VOA
GC/MS	Detector maintenance	Column change, unable to tune instrument	Clean detector, change pump oil	When responses drop and tunes start to fail	Tune passes, air and water are not present in the scan	Disassemble detector and check parts, check heating element, reanalyze tune	Analyst/Department Manager	2.4 MS VOA
GC-FID/TCD	Detector maintenance	Column change, unable to pass CCV criteria	Clean detector	When responses start to drop	CCV passes criteria (WS #24)	Disassemble detector and clean check parts, check heating element rerun standards	Analyst/Department Manager	AM20Gax

SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection (Personnel/Organization): Shaw E&I Field Technician or Shaw E&I Project Chemist

Sample Packaging (Personnel/Organization): Shaw E&I Field Technician or Shaw E&I Project Chemist

Coordination of Shipment (Personnel/Organization): Shaw E&I Field Technician or Shaw E&I Project Chemist

Type of Shipment/Carrier: United Postal Service

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): C&T; Microseeps

Sample Custody and Storage (Personnel/Organization): C&T; Microseeps

Sample Preparation (Personnel/Organization): C&T; Microseeps

Sample Determinative Analysis (Personnel/Organization): C&T Analyst/Chemist

SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): Shipped to laboratory the same day as collection

Lab Sample Storage (No. of days from sample collection): At least 30 days after completion of analyses

Sample Extract/Digestate Storage (No. of days from extraction/digestion): At least 30 days after completion of analyses

Biological Sample Storage (No. of days from sample collection): Not applicable to this project

SAMPLE DISPOSAL

Personnel/Organization: C&T; Microseeps

Number of Days from Analysis: 30 days

SAP Worksheet #27—Sample Custody Requirements Table

27.1 SAMPLE CUSTODY AND DOCUMENTATION

Sampling information will be recorded on a Chain of Custody Form and in a permanently bound field logbook. All entries will be legible and recorded in indelible ink.

27.2 SAMPLE LABELING

Sample labels will be filled out with indelible ink and affixed to each sample container. Non-waterproof sample labels will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory. Each sample container will be labeled with the following, at minimum:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Project number
- Sampler's initials
- Analyses to be performed
- Preservation (if any)
- Location (i.e., site name)

27.3 CHAIN-OF-CUSTODY

An example Chain of Custody Form is shown in Figure A4. In addition to providing a custody exchange record for the samples, the Chain of Custody Form serves as a formal request for sample analyses. The Chain of Custody Form will be completed, signed, and sent to the analytical laboratory with the sample shipment

After the laboratory receives the samples, the Sample Custodian will inventory each shipment before signing for it, and note on the original Chain of Custody Form any discrepancy in the number of samples, temperature of the cooler or broken samples. The Project Chemist will be notified immediately of any problems identified with shipped samples. The Project Chemist will in turn notify the Project QC Manager, and together they will determine the appropriate course of action. The Project Chemist will also notify the PM if the project budget and schedule may be impacted.

The laboratory will initiate an internal Chain of Custody Form that will track the sample within the various areas of the laboratory. The relinquishing signature of the Sample Custodian and the custody acceptance signature of the laboratory personnel transfer custody of the sample. This

procedure is followed each time a sample changes hands. The laboratory will archive the samples and maintain their custody as required by the contract or until further notification from the Project Chemist, at which time the samples will either be returned to the project for disposal, or disposed by the laboratory.

27.4 SAMPLE PACKING AND SHIPMENT

After sample collection, sample labels will be affixed to each sample container. Each sample will be placed in a resealable plastic bag to keep the sample container and the label dry. All glass sample containers will be protected with bubble wrap (or other cushioning material) to prevent breakage. A temperature blank will be placed in every cooler with samples.

Samples to be shipped by commercial carrier will be packed in a sample cooler lined with a plastic bag. Ice, double bagged in resealable bags, will be added to the cooler in sufficient quantity to keep the samples cooled to $4\pm 2^{\circ}\text{C}$ for the duration of the shipment to the laboratory. Sample cooler drain spouts will be taped from the inside and outside of the cooler to prevent any leakage. Saturday deliveries will be coordinated with the laboratory.

If a commercial carrier is used, the Chain of Custody Form will include the airbill number in the "Transfers Accepted By" column, and will be sealed in a resealable bag. The Chain of Custody Form will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape, and two custody seals will be taped across the cooler lid. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then be shipped to the analytical laboratory. A copy of the courier airbill will be retained for documentation.

The shipping of samples to the analytical laboratory by land delivery services will be performed according to the U.S. Department of Transportation regulations. The International Air Transportation Association regulations will be adhered to when shipping samples by air courier services. Transportation methods will be selected to assure that the samples arrive at the laboratory in time to permit testing according to established holding times and project schedules. No samples will be accepted by the receiving laboratory without a properly prepared Chain of Custody Form record and properly labeled and sealed shipping container(s).

27.5 FIELD LOGBOOKS

A permanently bound field logbook with consecutively numbered pages will be assigned to this project. All entries will be recorded in indelible ink. Corrections will be made following the procedure described below in Section 27.6, "Document Corrections." At the end of each workday, the responsible sampler will sign the logbook pages, and any unused portions of a logbook page will be crossed out, signed, and dated.

At a minimum, the logbook will contain the following information:

- Project name and location (on the front page of the log book)
- Date and time of collection for each sample (in the upper right corner of each page)
- Sample number
- Sample location (i.e., soil boring or sampling point)
- Sample type (i.e., soil and water)
- Composite or grab
- Composite type (the number of grab samples)
- Depth of sample
- Weather information (e.g., rain, sunny, approximate temperature, etc.)
- Containers used and requested analyses

In the graph paper portion of the field logbook, the sampler will fill in the following information:

- A map with sample locations (drawn or paste copy). Each sample location must be clearly identified on the map. Several sample locations may be presented on one map; however, the page with the map must be referred on each of the individual sample pages.
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments.
- Descriptions of deviations from this SAP.
- Problems encountered and corrective action taken.
- Identification of field QC samples.
- List of QC activities.
- Verbal or written instructions from the Navy and Shaw E&I Project QC Manager.

The sampler will cross out the unused portion and sign each page.

27.6 DOCUMENT CORRECTIONS

Changes or corrections on any project documentation will be made by crossing out the item with a single line, initialing by the person performing the correction, and dating the correction. The original item, although erroneous, will remain legible beneath the cross out. The new information will be written above the crossed-out item. Corrections will be written clearly and legibly with indelible ink.

SAP Worksheet #28.1—Laboratory QC Samples Table (EPA Method 8260B)

Matrix	Soil/Water					
Analytical Group	VOCs					
Analytical Method/SOP Reference	EPA Method 8260B/C&T 2.4					
QC Check	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Check of mass spectral ion intensities using bromofluorobenzene	Prior to ICAL and calibration verification	Must meet the method requirements before samples are analyzed (see WS #24)	Retune instrument and verify the tune acceptability	Lab Manager/Analyst	Representativeness	Meets all EPA Method requirements (see WS #24)
Internal standards	During acquisition of calibration standard, samples, and QC check samples	Areas within -50% to +100% of ICAL midpoint standard	Inspect GC/MS for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning	Lab Manager/Analyst	Representativeness	Areas within -50% to +100% of ICAL midpoint standard
Method blank	One per analytical batch	No target analytes $\geq \frac{1}{2}$ LOQ For common laboratory contaminants, no analytes detected >LOQ	Determine the source of blank contamination, If necessary, re-extract and reanalyze method blank and all samples processed with the contaminated blank	Lab Manager/Analyst	Representativeness ; Bias Contamination	No target analytes $\geq \frac{1}{2}$ LOQ For common laboratory contaminants, no analytes detected >LOQ
MS/MSD for all analytes	One MS/MSD per analytical/preparation batch	DoD QSM (2010) control Limits if available if no DoD control limits specified then use laboratory control limits	Identify problem; if not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples	Lab Manager/Analyst	Precision and Accuracy	DoD QSM control Limits if available if no DoD control limits specified then use laboratory control limits

SAP Worksheet #28.1—Laboratory QC Samples Table (EPA Method 8260B) (continued)

Matrix	Soil/Water					
Analytical Group	VOCs					
Analytical Method/SOP Reference	EPA Method 8260B/C&T 2.4					
QC Check	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD per analytical/preparation batch	DoD QSM control Limits	Identify the problem, then re-extract and reanalyze the LCS (LCS/LCD) and all associated batch samples	Lab Manager/Analyst	Precision and Accuracy	DoD QSM control Limits
Surrogate standards	Every sample, spiked sample, standard, and method blank	DoD QSM control Limits	Identify problem; if not related to matrix interference, reanalyze the extract or re-extract and reanalyze all affected samples	Lab Manager/Analyst	Accuracy	DoD QSM control Limits 1,2-Dichloroethane-d ₄ - 70% – 120% 4-Bromofluorobenzene- 70% – 120% Dibromofluoromethand - 85% – 115% Toluene-d ₈ - 85% – 120%

SAP Worksheet #28.2 – Laboratory QC Samples Table (Dissolved Gases)

Matrix	Water					
Analytical Group	Dissolved gasses					
Analytical Method / SOP Reference	AM20GAX					
QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Actions	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method blank	One per analytical batch (20 samples or less)	No target analytes \geq ½ RL	Determine the source of contamination, reanalyze blank, then reanalyze method blank and all samples processed with the contaminated blank	Lab Manager / Analyst	Representativeness	No target analytes \geq ½ RL
MS/MSD	MS/MSD pair only analyzed if specifically requested by client – not included in batch QC	Laboratory control limits	Identify problem; if not related to matrix interference, evaluate LCS results; Narrate	Lab Manager / Analyst	Precisions and Accuracy	Laboratory control limits Methane- 70% -130% Ethane- 70% -130% Ethene- 70% -130% Acetylene- 70% -130% RPD- \leq 20%
LCS/LCD pair	One LCS or LCS/LCD pair per analytical/preparation batch (20 samples or less)	Laboratory control limits	Identify the problem; reanalyze the LCS or re-extract and reanalyze the LCS and all associated batch samples	Lab Manager / Analyst	Precisions and Accuracy	Laboratory control limits Methane- 80% -120% Ethane- 80% -120% Ethene- 80% -120% Acetylene- 80% -120% RPD- \leq 20%
MDL study	Once per 12-month period	Detection limits will be below the RLs	Repeat the MDL study	Lab Manager / Analyst	Representativeness	Detection limits will be below the RLs

SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
Work Plan and Final SAP	Shaw E&I Project file NAVFAC SW Environmental Restoration Program (ERP) Record File for CERCLA Sites
Field notes/logbook	Shaw E&I Project file NAVFAC SW ERP Record File for CERCLA Sites
Chain-of-custody forms	Shaw E&I Project file NAVFAC SW ERP Record File for CERCLA Sites
Laboratory raw data package	Shaw E&I Project file NAVFAC SW ERP Record File for CERCLA Sites
Audit/assessment checklists/reports	Shaw E&I Project file NAVFAC SW ERP Record File for CERCLA Sites
Corrective action forms/reports	Shaw E&I Project file and laboratory
Laboratory equipment calibration logs	Laboratory—C&T and Microseeps
Sample preparation logs	Laboratory—C&T and Microseeps
Run logs	Laboratory—C&T and Microseeps
Sample disposal records	Laboratory—C&T and Microseeps
Laboratory Data and Data Validation Reports	Shaw E&I Project file NAVFAC SW ERP Record File for CERCLA Sites
SCAPS Reports	Shaw E&I Project file Supplemental Investigation Technical Memo NAVFAC SW ERP Record File for CERCLA Sites

SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization ¹ (Name, Address, Contact, and Telephone #)	Backup Laboratory (Name, Address, Contact, and Telephone #)
Soil/Water	VOCs	All samples listed in WS #18	8260B	14 to 21 business days	Curtis and Tompkins 2323 5th Street Berkeley, California 94710 510.204.2225	EMAX Laboratories, Inc. 1835 W. 205th St. Torrance, California 90501 Ye Myint 310.618.8889
Water	Dissolved Gasses	All Groundwater samples WS #18	Microseeps AM20GAX	14 to 21 business days	Microseeps University of Pittsburg Applied Research Center 220 William Pitt Way Pittsburg, Pennsylvania 15238 Robert J. Pirkle 412.826.5245	EMAX Laboratories, Inc. 1835 W. 205th St. Torrance, California 90501 Ye Myint 310.618.8889

Note:

¹All analytical laboratories performing certified analyses (dissolved gas analysis does not apply) are State of California National Environmental Lab Accredited Program and DoD Environmental Lab Accredited Program accredited laboratories.

SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Field audits	At least once at the beginning of sampling activities and then as needed as the project progresses	I	Shaw E&I and/or Navy QA Officer	Junn Masongsong; Program Chemist; or Navy QAO	Junn Masongsong; (Project Chemist or Program Chemist)	Junn Masongsong; (Project Chemist or Program Chemist)	Junn Masongsong; (Project Chemist or Program Chemist)
Field documentation review	At least once at the beginning of sampling activities and then as needed as the project progresses	I	Shaw E&I	Shaw E&I Program Chemist or Field QA Manager	Shaw E&I Technical Manager; Field Sampling Technician or Project Chemist	Shaw E&I Technical Manager; Field Sampling Technician or Project Chemist	Shaw E&I Program Chemist or Field QC Manager
Laboratory Data Review Findings	At least once at the beginning of sampling activities and then as needed as the project progresses	I	Shaw E&I	Program Chemist or Project QC Manager	Shaw E&I Technical Manager; Field Sampling Technician or Project Chemist	Shaw E&I Technical Manager; Field Sampling Technician or Project Chemist	Program Chemist or Field QC Manager

SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Sampling Technical System Audit	Written Audit Report	PM: Neil Hey	48 hours after audit	Email or letter	Field Technician, Shaw E&I Project Chemist (Junn Masongsong), Shaw E&I Program Chemist (Rose Condit)	24 hours after notification
Field documentation audits	Written Audit Report	PM, Field Technicians, Project QC Manager, Project Chemist	48 hours after audit	Email or letter	Field Technician, Shaw E&I Project Chemist (Junn Masongsong), Shaw E&I Program Chemist (Rose Condit)	24 hours after notification
Laboratory Data Review Findings	Memo	Laboratory QA Manager, Laboratory PM	48 hours after audit	Email or letter	Shaw E&I Project Chemist (Junn Masongsong), Shaw E&I Program Chemist (Rose Condit)	3 days after notification

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Sampling Technical Audit Report Initial and Follow up inspections	At least once at the beginning of sampling activities and then as needed as the project progresses	Within 24 hours of Field Sampling Audit	Shaw E&I QC Manager (Mark Vennemeyer) or Shaw E&I Project Chemist (Junn Masongsong)	Shaw E&I PM (Neil Hey)
Data Review Report	After all waste sample data reviewed by Project Chemist	As received from laboratory	Shaw E&I Project Chemist (Junn Masongsong) or Shaw E&I Program Chemist (Rose Condit)	Shaw E&I Project Engineer or Shaw E&I PM (Neil Hey)
Final Project Report	After completion of all field work	Project document delivery schedule is provided in the Work Plan Figure 3	Shaw E&I PM (Neil Hey)	NAVFAC SW RPM and regulatory agencies (see distribution list, WS #3)

SAP Worksheet #34—Verification (Step I) Process Table

Verification Input	Description	Internal (I)/ External (E)	Responsible for Verification (Name, Organization)
Chain of custody forms	Chain of Custody Forms will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody should be initialed by the reviewer, a copy of the chain-of-custody retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	I	Field sampling team leader (Shaw E&I) or Project Chemist (Junn Masongsong)
Field notes/logbook	Field notes will be reviewed internally and placed in the project file upon project completion.	I	Project Chemist (Junn Masongsong)
Audit reports	Upon report completion, a copy of all audit reports will be placed in the project file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the project file. At the beginning of each week, and at the completion of the site work, project file audit reports will be reviewed internally to ensure that all appropriate corrective actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the PM will be notified to ensure action is taken.	I	Shaw E&I Project Engineer or Shaw E&I PM (Neil Hey)
Laboratory data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. All received data packages will be verified by the Shaw E&I Chemist according to the data validation procedures specified in this SAP.	I/E	C&T, The Data Validation Group, and Shaw E&I Chemist and PM

SAP Worksheet #35—Validation (Steps IIa and IIb) Process Table

Step IIa/IIb ¹	Validation Input	Description	Responsible for Validation
IIa	Sampling Methods and Procedures	Ensure that the required sampling methods were used to collect project samples, any field changes or deviations are noted in the field logbook. Review field sample collection logbooks for compliance with the Approved SAP.	Project Chemist (Junn Masongsong)
IIa	Holding times	Ensure the samples were analyzed within the EPA holding times. If holding times were not met, verify that deviations were documented and proper notifications were made.	Shaw Project Chemist, Third party data validation company (The Data Validation Group [DVG])
IIa	Analytes	Ensure that the required list of analytes was reported per project requirements.	Shaw Project Chemist and DVG
IIa	Hardcopy data packages	Review data package for compliance with EPA Method Requirements, DoD QSM (2010) and project SAP requirements.	Shaw Project Chemist and DVG
IIa	Documentation of all DoD QSM and EPA Method QC sample Results	Determine if all DoD QSM requirements and EPA Method required QC samples were analyzed and met required control limits per SAP.	Shaw Project Chemist and DVG
IIb	Documentation of all SAP QC sample Results	Determine if all SAP required QC samples were collected and met required control limits per SAP and DoD QSM requirements where applicable.	Shaw Project Chemist and DVG
IIb	Sampling Plan	Determine whether the SAP was executed as specified (number, location, type of field samples collected).	Project Chemist (Junn Masongsong) or Program Chemist (Rose Condit)
IIb	Sampling Procedures	Evaluate whether sampling procedures were followed with respect to techniques, decontamination, sample volume and preservation.	Project Chemist (Junn Masongsong) or Project QC Manager
IIb	Field duplicate precision	Compare results for field duplicates with criteria established in the SAP.	Shaw Project Chemist and DVG
IIb	Project Quantitation Limit Goals met	Review all laboratory data to ensure that project-specific quantitation limits specified in the SAP are met.	Shaw Project Chemist
IIb	Method performance criteria	Evaluate laboratory QC data against project-specific criteria.	Shaw Project Chemist and DVG

Notes:

¹ IIa=compliance with methods, procedures, and contracts.

IIb=comparison with measurement performance criteria in the SAP.

SAP Worksheet #36—Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	Soil/Water	VOCs	In accordance with DoD QSM (2010), project specific SAP criteria, validation criteria specified in WS#14 (Section 14.8) and EPA Level III and IV	Shaw Project Chemist and DVG
IIa	Water	Dissolved Gasses	In accordance requirements specified in WS#24 and WS#28 method performance criteria	Data review only by Shaw Project Chemist
IIb	Soil/Water	VOCs	In accordance with criteria specified in DoD QSM (2010) and additional guidance from EPA National Functional Guidelines.	Shaw E&I Project Chemist and The Data Validation Group PM

Notes:

¹ IIa=compliance with methods, procedures, and contracts.

IIb=comparison with measurement performance criteria in the SAP.

SAP Worksheet #37—Usability Assessment

37.1 DATA QUALITY ASSESSMENT REPORT

Based on data validation/review, the Project Chemist will determine if the project DQOs have been met, and will calculate data completeness. To reconcile the collected data with project DQOs and to establish and document data usability, the data will be reviewed against data quality indicators (Section 37.2).

The Project Chemist will prepare a Data Quality Assessment (DQA) Report. The DQA Report will cover the following topics:

- Implementation of sampling design and analysis according to the approved SAP (or sample completeness and representativeness)
- Proper frequency of field QC samples and the adequacy of field decontamination procedures
- Accuracy and precision of the data collected
- Data comparability, if appropriate
- Data usability for project decisions

The DQA Report will be included in the Final Project Report.

37.2 DATA QUALITY INDICATORS

This section defines the data quality indicators and their use for assessment of data quality.

37.2.1 Precision

Precision measures the reproducibility of measurements under a given set of conditions. The following equation illustrates the method for calculating RPD to assess a method's precision:

$$\text{Precision as RPD} = \frac{2 \times |\text{Result-Duplicate Result}| \times 100\%}{\text{Result} + \text{Duplicate Result}}$$

The laboratory uses MS/MSD pairs to assess the precision of analytical procedures, with one MS/MSD pair analyzed for every batch of up to 20 samples. According to the Navy requirements, analytical laboratories perform MS/MSD on the Navy project samples. This allows determining whether matrix interferences may be present.

The laboratory uses LCS/LCD pairs when MS are not practical due to the nature of sample or analytical method used, and they are prepared and analyzed with each batch of samples instead of MS/MSD. LCS/LCD may also be prepared in place of MS/MSD in the case that a sufficient sample volume was not obtained in the field to perform the MS/MSD analysis. For inorganic

analyses, analytical precision is usually calculated based on the sample and sample duplicate results.

Analytical laboratory will use DoD QSM (2010) acceptability limits for RPDs if available. If DoD limits are not available, then the laboratory will established statistically based acceptability limits for RPDs for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. Any suspect trends will be investigated and corrective actions taken.

The variability of the contaminant distribution in the sampled matrix is evaluated by collecting and analyzing “blind” field duplicate samples (field QC samples) at a rate of one for every 10 samples. Field precision will be evaluated based on the RPD for field duplicate sample pairs. The field duplicates also provide information on the precision of sample collection and handling in the field.

Field precision will be monitored to evaluate the sampling techniques and sample handling procedures. Although field precision will reviewed during the data validation process, sample results will not be qualified based on the field precision values.

37.2.2 Accuracy

Accuracy measures the bias of an analytical system by comparing the difference of a measurement with a reference value. The percent recovery of an analyte, which has been added to the environmental samples at a known concentration before extraction and analysis, provides a quantitative tool for analytical accuracy. The spiking solutions used for accuracy determinations are not used for instrument calibrations. The following equation illustrates how accuracy is evaluated:

$$\text{Accuracy as percent recovery} = \frac{\text{Spiked Sample Result} - \text{Sample Result} \times 100\%}{\text{Spiked Sample True Value}}$$

Percent recoveries for MS, MSD, and LCS that are analyzed for every batch of up to 20 samples serve as a measure of analytical accuracy. Surrogate standards are added to all samples, blanks, MSs, MSDs, and LCSs analyzed for organic contaminants to evaluate the method’s accuracy and to help determine matrix interferences.

The analytical laboratory will use DoD QSM (2010) acceptability limits for percent recoveries of surrogates and MS/MSD samples if available. If DoD limits are not available, then the laboratory will established statistically based acceptability limits for RPDs for each method of analysis and sample matrix. The laboratory will review the QC samples to ensure that internal QC data lies within the limits of acceptability. The laboratory will investigate any suspect trends and take appropriate corrective actions.

37.2.3 Representativeness

Unlike precision and accuracy, which can be expressed in quantitative terms, representativeness is a qualitative parameter. Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Field personnel will be responsible for ensuring that samples are representative of field conditions by collecting and handling samples according to the approved site-specific SAP, this Chemical Data Quality Management Plan, and field SOPs. Errors in sample collection, packaging, preservation, or chain-of-custody procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

Data generated by the laboratory must be representative of the laboratory database of accuracy and precision measurements for analytes in different matrices. Laboratory procedures for sample preparation will ensure that aliquots used for analysis are representative of the whole sample. Aliquots to be analyzed for volatile parameters will be removed before the laboratory composites/homogenizes the samples, to avoid losing volatile compounds during mixing.

37.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during inter-laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data.

Sample collection and handling procedures will adhere to EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units, standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

37.2.5 Completeness

Completeness is a measure of whether all the data necessary to meet the project have been collected. For the data to be considered complete it must meet all acceptance criteria including accuracy and precision and other criteria specified for an analytical method. The data will be reviewed and/or validated to keep invalid data from being processed through data collection. Completeness will be evaluated for the target VOC compounds only and is evaluated using the following equation:

$$\text{Completeness} = \frac{\text{Acceptable Results} \times 100\%}{\text{Total Results}}$$

The goal for completeness for all QC parameters, except holding times, will be 90 percent. The goal for holding times will be 100 percent. If these goals are not achieved, the sources of nonconformances will be evaluated to determine whether re-sampling and re-analysis is necessary.

37.3 PROJECT-REQUIRED QUANTITATION LIMITS

Following the laboratory will determine the method detection limits, LOQs, and limits of detection for each method, instrument, analyte and matrix by using the procedure described DoD QSM (2010). The laboratory limits of detection and LOQ will be below the project quantitation limit goals (WS #15).

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FIGURES

IMAGE X-REF ---

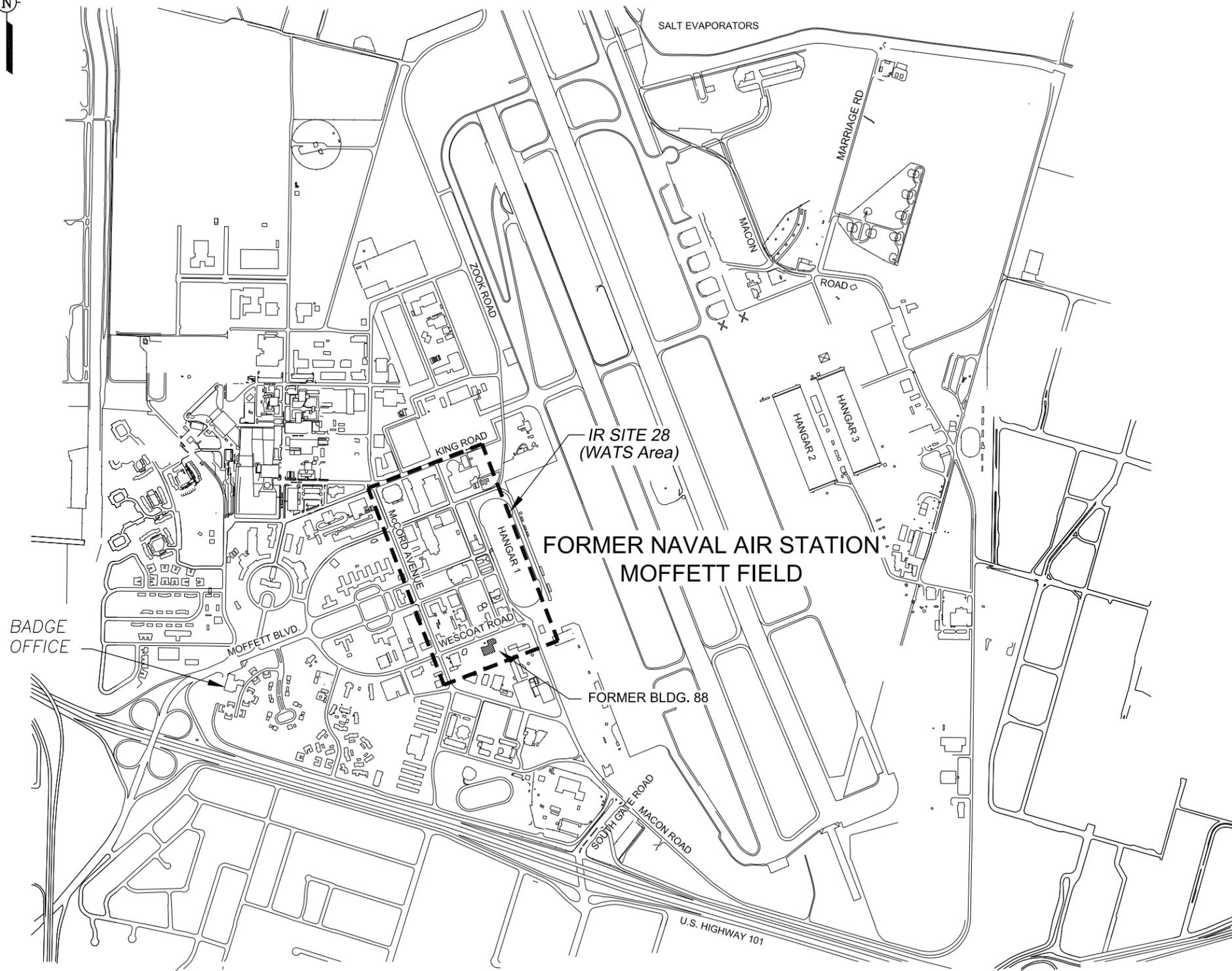
OFFICE CONCORD

DRAWN BY KAB 02/25/10

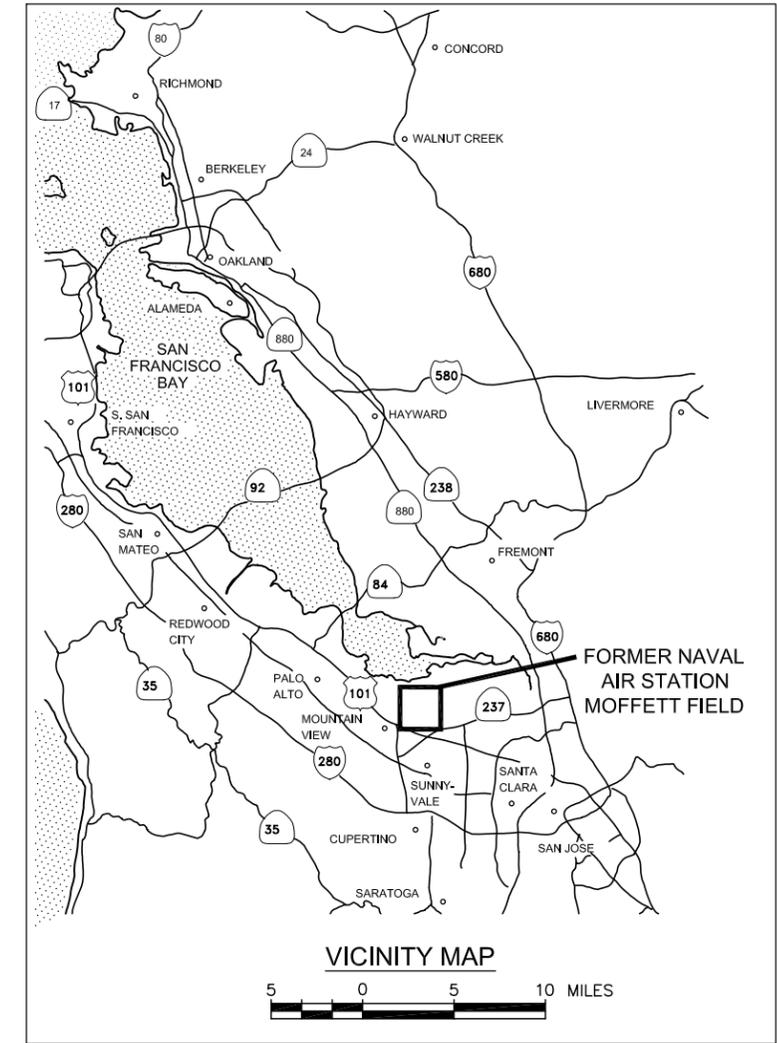
CHECKED BY DL 03/10/10

APPROVED BY NH 03/10/10

DRAWING NUMBER 144002-B3

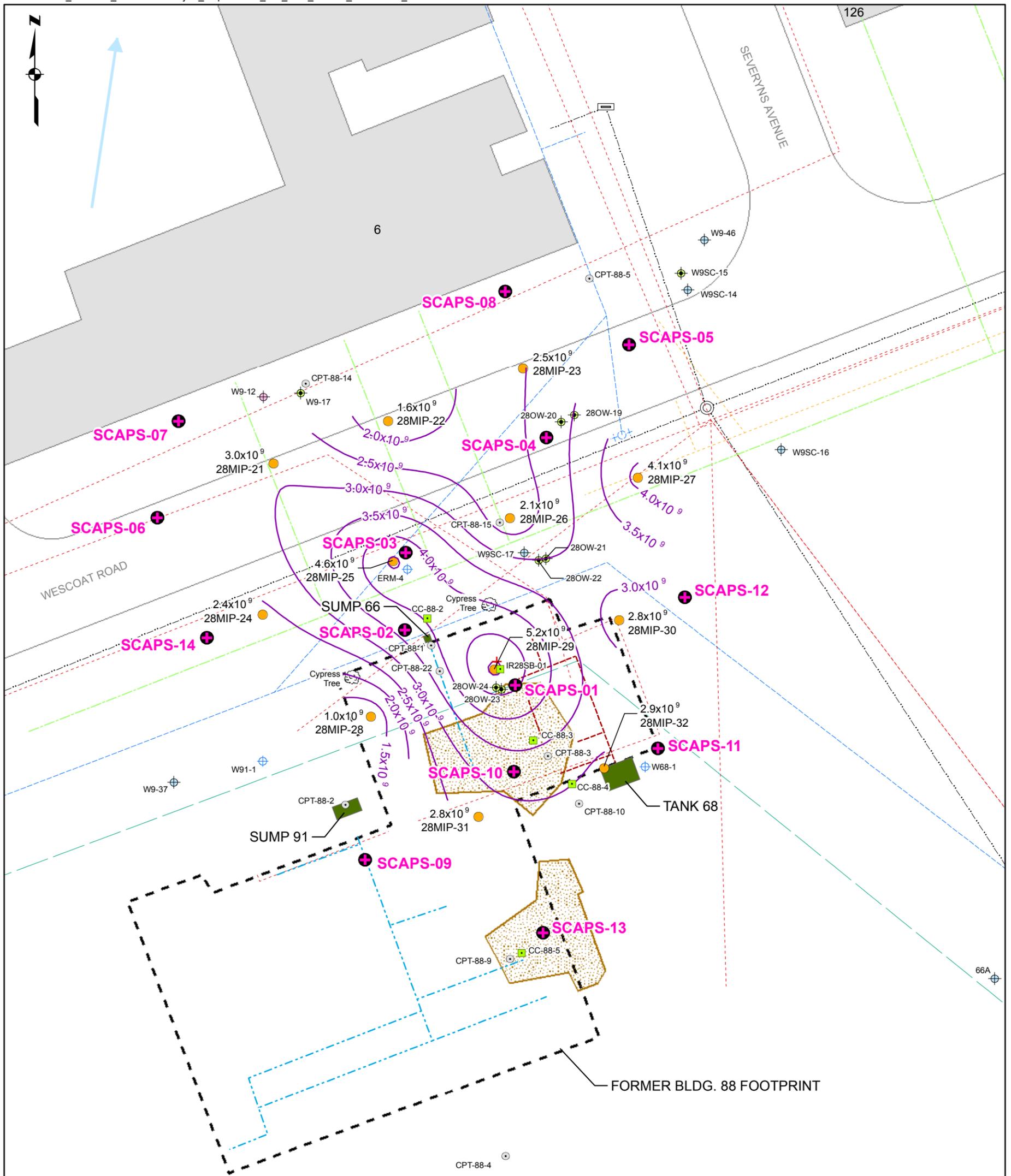


SITE LOCATION MAP
 600' 0 600' 1200'



VICINITY MAP
 5 0 5 10 MILES

	<p>BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST NAVAL FACILITIES ENGINEERING COMMAND SAN DIEGO, CALIFORNIA</p>
<p>FIGURE A1 SITE LOCATION MAP FORMER NAS MOFFETT FIELD MOFFETT FIELD, CALIFORNIA</p>	

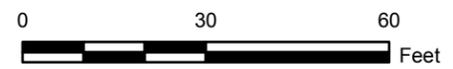


Legend

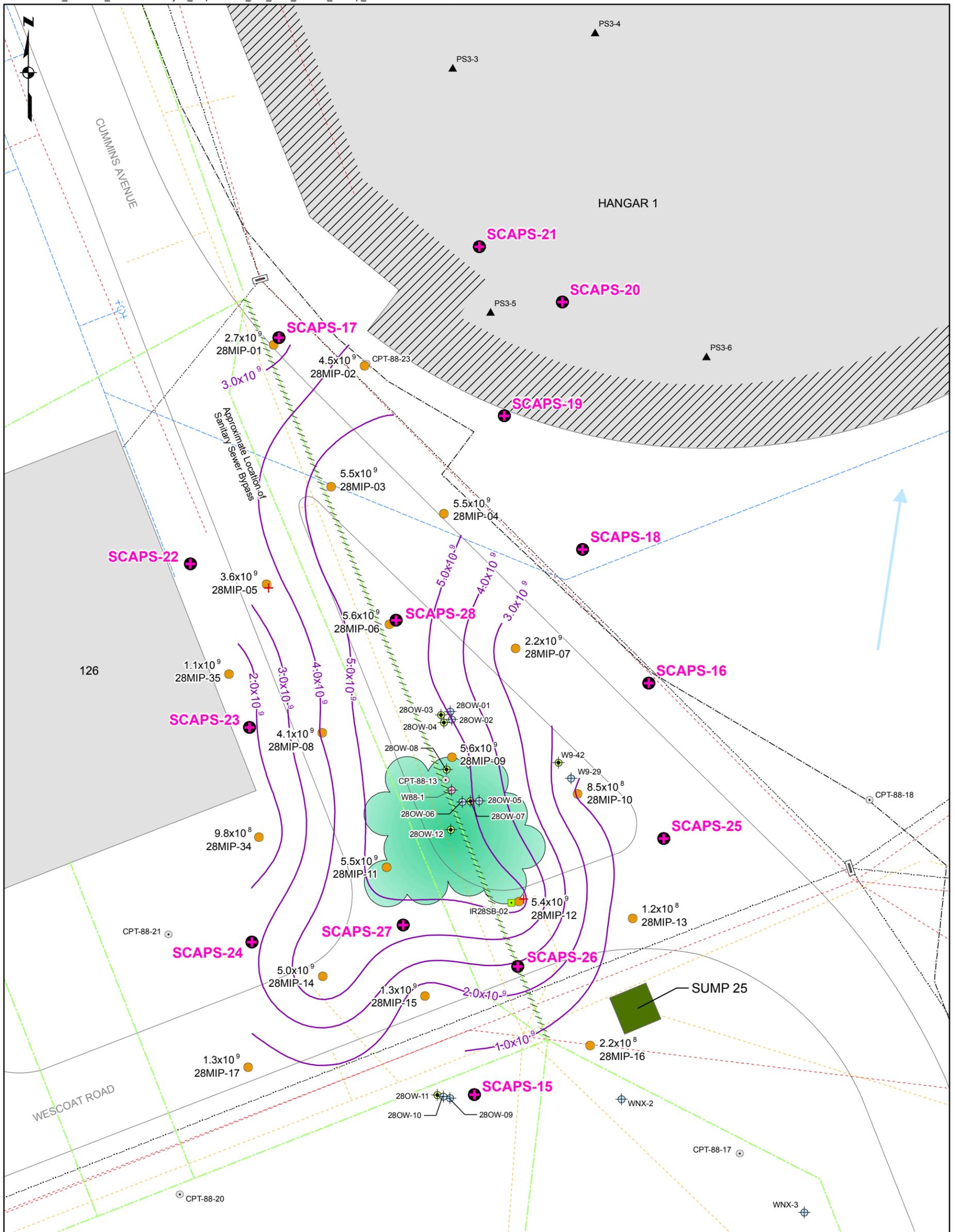
- MIP Location⁽¹⁾
- 1.4x10⁹ Sum of ECD Response in Microvolts for 0 to 25 ft bgs Interval
- ~ ECD Response Isopleth (μV)
- + NAPL FLUTE™ Test Location⁽¹⁾
- Continuous Core Location^(1,2)
- ⊕ Upper A-Aquifer Monitoring Well
- ⊕ Lower A-Aquifer Monitoring Well
- ⊕ B2-Aquifer Monitoring Well
- ⊕ A-Aquifer Extraction Well
- ⊕ Former Groundwater Monitoring Well
- ⊕ CPT Location⁽²⁾
- Storm Drain Line
- Sanitary Sewer Line
- Communication
- Electric
- Gas
- Water
- Concrete-lined Wastewater Collection Trench (Removed)
- Floor Drain Piping (Removed)
- Fence
- ← Groundwater Flow Direction⁽³⁾

- ⊕ Proposed Tier 1 SCAPS Location
- Previous Remedial Excavation Area (7 to 8 ft. bgs)⁽²⁾
- Sump or Tank (Removed)
- 503 Building and Building Number

¹ Final Progress Report, In Situ Anaerobic Biotic/Abiotic Treatability Study, IR Site 28 (Shaw, 2010).
² Final Former Building 88 Investigation Report (TIECI, 2008).
³ Based on March 2010 Potentiometric Surface Data for the Upper A-Aquifer (Brown and Caldwell, 2011).



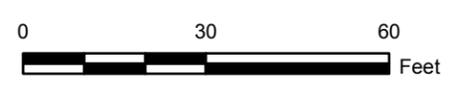
	BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST NAVAL FACILITIES ENGINEERING COMMAND SAN DIEGO, CALIFORNIA
	FIGURE A2 SCAPS TEST LOCATIONS CONCEPTUAL LAYOUT BUILDING 88 AREA IR SITE 28, FORMER NAS MOFFETT FIELD MOFFETT FIELD, CALIFORNIA



Legend

- MIP Location⁽¹⁾
- Sum of ECD Response in Microvolts for 46 to 65 ft bgs Interval
- ~ ECD Response Isopleth (μV)
- ⊕ NAPL FLUTE™ Test Location⁽¹⁾
- Continuous Core Location⁽¹⁾
- ⊕ Upper A-Aquifer Monitoring Well
- ⊕ Lower A-Aquifer Monitoring Well
- ⊕ B2-Aquifer Monitoring Well
- ⊕ A-Aquifer Extraction Well
- CPT Location⁽²⁾
- ▲ NASA Sample Location⁽³⁾
- Storm Drain Line
- Sanitary Sewer Line
- Sanitary Sewer Line that Reportedly Collapsed⁽⁴⁾
- Communication
- Electric
- Gas
- Water
- Fence
- ← Groundwater Flow Direction⁽⁵⁾

- ⊕ Proposed Tier 1 SCAPS Location
 - In Situ Bioremediation Treatment Test Area (10 to 65 ft bgs)⁽¹⁾
 - /// No Drilling - Surface Obstruction
 - Oil/Water Separator (Removed)
 - 503 Building and Building Number
- ¹ Final Progress Report, In Situ Anaerobic Biotic/Abiotic Treatability Study, IR Site 28 (Shaw, 2010).
² Final Former Building 88 Investigation Report (Tetra Tech, 2008).
³ NASA Sensitive but Unclassified Information Memorandum Text, Tables, and Figures (PRC, 1995).
⁴ Based on March 2010 Potentiometric Surface Data for the Upper A-Aquifer (Brown and Caldwell, 2011).



	BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST NAVAL FACILITIES ENGINEERING COMMAND SAN DIEGO, CALIFORNIA
	FIGURE A3 SCAPS TEST LOCATIONS CONCEPTUAL LAYOUT TRAFFIC ISLAND AREA IR SITE 28, FORMER NAS MOFFETT FIELD MOFFETT FIELD, CALIFORNIA

Attachment 1
Meeting Minutes
PQO and Work Plan Development Meeting–IR Site 28

**TEAM MEETING MINUTES
SUPPLEMENTAL INVESTIGATION KICKOFF
IR SITE 28, FORMER NAS MOFFETT FIELD**

Tuesday, October 25, 2011

PARTICIPANTS:

Present: Penny Reddy (U.S. Environmental Protection Agency, Region 9 [EPA]), Elizabeth Wells (California Regional Water Quality Control Board, San Francisco Bay Region [Water Board]), Neil Hey (Shaw Environmental, Inc. [Shaw]), Dan Leigh (Shaw)

Via Phone: Jim Whitcomb (U.S. Navy, Naval Facilities Engineering Command Southwest [Navy]), Valerie Harris (Navy)

MEETING OBJECTIVE:

The primary objective of this meeting was to present the conceptual approach and solicit input from the regulatory stakeholders on the planned supplemental investigation of the Navy's subsurface sources of chlorinated ethenes (CEs) to groundwater at IR Site 28, Moffett Field, in support of developing the project plan.

DISCUSSIONS:

The meeting began with the Navy providing a general overview of the meeting objective, the problem that necessitates the study, and the goals of the planned investigation. The meeting objective is outlined above and the problem that necessitates the study and the study goals are outlined in the attached Preliminary Project Quality Objectives (PQOs) that were distributed to the attendees to facilitate and guide the discussions.

Subsequently, Shaw presented the conceptual plan for obtaining data to answer the study questions outlined in the PQOs. Figures were used to illustrate the conceptual layout for a combined membrane interface probe/cone penetrometer survey (performed using the Navy's Site Characterization and Analysis Penetrometer System [SCAPS]) at the two source areas (Former Building 88 Area and Traffic Island Area). The purpose of the survey is to generate data that further defines the lateral and vertical extent of COCs and soil stratigraphy in the areas of interest, which will be used, along with existing site data, to guide new monitoring well design and placement.

The EPA asked if the investigation will look at utility lines. The Navy explained that the investigation will not necessarily follow the utility lines but pointed out that several of the survey locations are along the sanitary sewer alignment. The Water Board provided the EPA a brief rundown of past investigations of the Navy sources (Former Building 88 and the collapsed sanitary sewer line in the Traffic Island) and the history behind identification of the related areas of interest.

The EPA asked if an objective of the investigation will be to identify what contamination is a result from on-flow and what is from Navy sources. The Navy indicated that the investigation is not designed to differentiate between contamination from on-flow versus Navy sources.

Shaw presented the conceptual plan for installing several new wells in the Traffic Island Area: one to monitor the deepest interval of the lower A-Aquifer upgradient of the Treatability Study

treatment area, one well to monitor the B2-Aquifer upgradient of existing well W88-1, one well to monitor the B2-Aquifer downgradient of existing well W88-1, and one well to monitor the next deeper permeable interval beneath existing well W88-1 (>85 feet below ground surface). A marked-up cross-section from the *Former Building 88 Investigation Report* (Tetra Tech EC, Inc., 2008) was used to illustrate the conceptual placement of these well screens.

Shaw briefly described the conceptual plan to install new wells in the former Building 88 Area including a well in the upper A-Aquifer within the high concentration area of the former building footprint and upgradient of the high concentration area.

Placement and design of the new wells will be refined and confirmed with all stakeholders prior to installation. The wells are proposed to be sampled twice in events that are at least 3-months apart and analyzed for volatile organic compounds and dissolved gasses (i.e., ethene, ethane, methane, and acetylene).

Shaw and the Navy described the plan to sample select existing wells to confirm the extent of the areas the EPA proposes to outline as “potential source areas” (i.e. >1,000 micrograms per liter of total CEs) at IR Site 28 in the forthcoming feasibility study for the regional groundwater plume. The wells will be a select set that are not monitored regularly by the Navy’s basewide groundwater monitoring program or the MEW plume regional groundwater monitoring program. A figure that shows the existing wells in the A-Aquifer and B-Aquifer at IR Site 28 was used to identify the proposed wells and their locations relative to the EPA identified “potential source areas.” The wells are proposed to be sampled twice in events that are at least 3-months apart and analyzed for volatile organic compounds and dissolved gasses (i.e., ethene, ethane, methane, and acetylene). The Water Board suggested expediting collection of these samples so that the results can be considered for the EPA’s figure before it is published in the draft feasibility study. Amending existing plans was discussed and will be considered by the Navy. The Water Board suggested revising the second of the primary goals listed in the PQOs to read as follows: “...confirm EPA identified “potential source areas” in IR Site 28 using existing monitoring wells.”

Shaw presented the plan to continue monitoring the observation wells within and downgradient of the EHC[®] treatment pilot study area and the emulsified vegetable oil treatment pilot study area. The wells will be sampled twice in events that are at least 3-months apart and analyzed for the same analytical suite monitored during the In Situ Anaerobic Biotic/Abiotic Treatability Study of 2010-2011.

ACTION ITEMS:

- Navy to explore amending the Sampling and Analysis Plan (Shaw, 2010) for the In Situ Anaerobic Biotic/Abiotic Treatability Study in order to expedite collection of the groundwater samples from the EPA identified “potential source areas.”
 - Navy to look into the reason why wells W9-1 and W9-6 were not selected to be sampled as part of the EPA “potential source areas” confirmation effort.
 - EPA, Navy, and Shaw to read and consider the regulatory agency comments made about well W88-1 in the *Former Building 88 Investigation Report* (TtECI, 2008).
 - Navy to resend the EPA the diagram prepared by Shaw in 2009 that was used to evaluate the depth of the sanitary sewer line relative to the water table. .
-

Attachment 2
Laboratory SOPs
(provided on electronic copy only)

Microseeps, Incorporated

Analytical Method AM20GAx

Standard Operating Procedure for the

Analysis of Biodegradation Indicator Gases

Controlled Copy No. _____



Mark Mikesell
Laboratory Manager

Signature of Final Approval:



Patrick McLoughlin, Ph.D.
Technical Director

12-5-2011
Effective Date

1.0 Scope and Application

Method AM20Gax is used to determine the concentration of biodegradation indicator gases in vapor samples. Specifically, Method AM20Gax is used to determine the dissolved concentration of the following gases:

Gases	CAS Number
Acetylene	74-86-2
Carbon dioxide	124-38-9
Oxygen	7782-44-7
Nitrogen	7727-37-9
Hydrogen	1333-74-0
Methane	74-82-8
Ethane	74-84-0
Ethene	74-85-1
Propane	74-98-6
Propene	115-07-1
n-Butane	106-97-8
i-Butane	75-28-5
Carbon Monoxide	630-08-0
Total Inorganic Carbon*	

*Total inorganic carbon (TIC) is converted to carbon dioxide using the steps outlined in SOP-PM01. The sample is then analyzed for carbon dioxide according to this SOP. Any differences in method are specified in the appropriate section.

This method is recommended for use by, or under the supervision of, analysts experienced in sample preparation, the operation of gas chromatographs and in the interpretation of chromatograms.

2.0 Method Summary

The sample gas is analyzed with a gas chromatograph capable of simultaneous analysis of all of the target analytes from a single gas sample. A single injection of gas from integral, simultaneously filled sample loops is used to assure consistent injection volume. The permanent gases are analyzed using a thermal conductivity detector (TCD). The light hydrocarbons are analyzed using a flame ionization detector (FID). Hydrogen is analyzed using a reduction gas detector (RGD). The data are transferred to a microcomputer, converted to digital format, stored, and processed using a chromatography data system.

2.1 Definitions

Batch: A batch consists of twenty or fewer samples.

Instrument Flush: The front end of the sample loop is flushed with ultra high purity helium injected into the loop directly from the cylinder to remove possible interference by ambient air and to avoid cross contamination between samples.

Method Blank: An injection analyzed by all three detectors that consists of ultra high purity helium. The method blank is free from the analytes of interest

Laboratory Control Sample: A sample of laboratory grade deionized water spiked with verified known amounts of analytes. A LCS is used to assess the performance of the measurement system.

Matrix Spike and Matrix Spike Duplicate: A sample prepared by adding a known concentration of target analyte to a specific amount of sample. Matrix spikes are used to determine the effect of sample matrix on a method's recovery efficiency.

3.0 Apparatus and Materials and Operating Conditions

3.1 Apparatus

Gas Chromatograph: The chromatographs designed and built by Microseeps are equipped with multiple packed columns and multi-port valves, a TCD, a FID, a RGD, and multiple sample loops. The FIDs, which were also built by Microseeps, are of a special design that allows considerably more sensitivity than commercially available models. This instrument provides rapid turn-around for consecutive analyses and a clean baseline for accurate, reproducible results.

3.2 Materials

- Sample vials (Supelco, Inc, Bellefonte, PA or equivalent)
- Syringe: locking gas tight (Hamilton/Alltech, 3, 5, 10, 30 and 60 ml or equivalent)
- Syringes: Disposable (60mL)

3.3.1 Interferences

The most likely source of "interference" is ambient air. Due to the relatively high concentrations of oxygen and nitrogen, a very small amount of air as a contaminant will dramatically affect the results. The analyst must take great care to ensure that air is flushed from the gas tight syringe

before sample preparation and that no air has entered the syringe or needle prior to injection of the sample into the gas chromatograph.

Contamination by carryover can occur whenever high-level and low-level samples are sequentially analyzed. An unrestricted flow (Instrument flush) of pure carrier gas from a 10 psig source should be allowed to flow through each sample loop for 30 seconds prior to each analysis.

As required, the analyst should demonstrate the absence of carryover contamination by analysis of the contents of the sample loop when purged with carrier gas. This demonstration should be performed when carryover contamination is suspected (after high samples). In the event that 'ghost peaks' (peaks similar to previous sample) appear when a pure carrier gas sample is analyzed (method blank), measures should be taken to eliminate the carryover contamination.

4.0 Reagents

- Helium (UHP Gas)
- Nitrogen (UHP Gas)
- Certified Commercial Gas Standards
- Benzalkonium chloride (BAK) solution – Prepared by dissolving 12.08 g into 1L DI water.
- Tri-sodium phosphate (TSP) – purchased as the dodecahydrate

4.1 Standard Preparation Procedures

Calibration standards are prepared by using the procedures below:

4.1. Vial Preparation

Headspace vials used for instrument calibration standards for this method are prepared as follows:

- Crimp and cap each vial, with stopper septa.
- Evacuate each vial to vacuum.
- Flush each vial to atmospheric pressure with the vial balance gas appropriate for the detector being calibrated. (See Table 4.1)

Table 4.1

Detector	Vial Balance Gas
FID	Nitrogen
TCD	Helium

RGD	Nitrogen
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4.1.1 Preparing Calibration Standards

The instrument is initially calibrated (ICAL) using dilutions of custom certified gas mixes.

- Prepare the correct number of vials for the detector being calibrated.
- Each of the three detectors is calibrated with a gas mix from a commercial source.
- Remove the specified amount of standard by extracting it from the standard mix gas cylinder using a gas-tight syringe and injecting it into a prepared vial.
- Add the specified amount of vial balance gas to the same vial.

The dilution factor of one is achieved by directly injecting the standard gas mix from the cylinder into the GC.

4.1.2 Calibration Standard Concentrations

Calibration standards are made up in the following concentrations as specified in Tables 4.1.2 A, B, C, D, and E. The true values of the calibration standards vary slightly from cylinder to cylinder. The values below are very close approximations. All standards are prepared using headspace vials with stopper septum or serum bottles.

Table 4.1.2 A
Light Hydrocarbons by FID
(Methane, Ethane, Ethene, Butane, Propane, Propene)

Stock-1000ppmv Hydrocarbon Mix in Nitrogen from Matheson Tri-Gas, or equivalent.

Std Level	Conc. (PPMV)	Std	Make-up Gas
Working Std #2	40.0	8cc Stock	192cc (w/serum bottle)
Working Std #3	5.00	1cc Stock	199cc (w/serum bottle)
Level 1	1000	As received from cylinder	0
Level 2	200	10cc Stock	40cc
Level 3	40.0	2cc Stock	48cc
Level 4	8.00	10cc Working Sol #2	40cc
Level 5	2.00	2.5cc Working Sol #2	47.5cc

Level 6	0.500	5cc Working Sol #3	45cc
Level 7	0.125	1cc Working Sol #3	39cc
Level 8	0.040	2cc Working Sol #3	248cc (w/serum bottle)

Table 4.1.2 B
Acetylene by FID

Stock-1000 PPMV Acetylene in Nitrogen, Matheson Tri-Gas, or equivalent.

Std Level	Conc. (PPMV)	Std	Make-up Gas
Working Sol #1	20.0	1cc Stock	49cc
Level 1	100	5cc Stock	45cc
Level 2	25	1cc Stock	39cc
Level 3	5.00	10cc Working Sol #1	30cc
Level 4	1.00	2.0cc Working Sol #1	38cc
Level 5	0.200	0.5cc Working Sol #1	49.5cc

Table 4.1.2 C
Hydrogen by RGD

Stock-100 PPMV Hydrogen in Nitrogen, Matheson Tri-Gas, or equivalent.

Level	Conc.	Std	Make-up Gas
Working Sol #4	2.00	1cc Stock	49cc
Level 1	50.0	21cc Stock	21cc
Level 2	20.0	10cc Stock	40cc
Level 3	10.0	5cc Stock	45cc
Level 4	5.00	2cc Stock	38cc
Level 5	2.00	1cc Stock	49cc
Level 6	0.500	10cc Working Sol #4	30cc

Level 7	0.200	4cc Working Sol #4	36cc
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Table 4.1.2 D
Permanent Gases by TCD
(Oxygen, Carbon Dioxide, Nitrogen, Methane, Carbon Monoxide)

Stock-Multi-component Mix at various conc. in Nitrogen, Matheson Tri-Gas, or equivalent.

Level	Std	Make-up Gas
Working Sol #5	1cc Stock	49cc
1	As received from cylinder	0
2	21cc Stock	21cc
3	5.0cc Stock	45cc
4	1.0cc Stock	49cc
5	0.5cc Stock	49.5cc
6	10cc Working Sol #5	40cc

Table 4.1.2 E
Permanent Gases by TCD
(Carbon Dioxide, Methane, Ethane, Ethene)

Stock-Single component sources, 100% Stock by Matheson Tri-Gas, or equivalent.

Std Level	Conc. (PPMV)	Std	Make-up Gas
Working Sol #6	20,000	5cc each comp	230cc (w/serum bottle)
Level 1	200,000 CO ₂ 100,000 MEE	10cc CO ₂ 5cc MEE	25cc
Level 2	50,000	2.5cc each comp	40cc
Level 3	10,000	25cc Working Sol #6	25cc
Level 4	2,000	5.0cc Working Sol #6	45cc

Level 5	400	1.0cc Working Sol #6	49cc
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4.2 Quality Control Sample Preparation

Quality control samples are prepared as indicated below.

4.2.1 Initial Calibration Verification (ICV) and Continuing Calibration Verification (CCV)

The ICV and CCV are prepared from a source different from the source used to prepare the ICAL standards. The concentration of the ICV and CCV is in the middle of the calibration range and is close to that of the ICAL midpoint, but because of the nature of gas standard it is not at exactly that concentration.

4.2.2 Laboratory Control Sample (LCS) and LCS Duplicate (LCSD)

The LCS and LCSD are prepared at a mid-range concentration. The type of LCS/LCSD depends upon the original matrix of the sample. For samples that arrive as vapors, the LCS/LCSD is injected as a gas. For samples that arrive as waters, DI water is spiked with a gas mixture of target analytes and prepared the same as the samples. Water that is free of the principle atmospheric components of nitrogen and oxygen is very difficult to make and similarly difficult to store. Toward that end, LCS/LCSD results for nitrogen or oxygen will not be reported with client data. Table 4.2.2 below gives the true values of the LCS/LCSDs.

4.2.2.1 Total Inorganic Carbon LCS

Mix approximately 0.20g NaHCO₃ into 200ml laboratory grade DI water, prepare according to the TIC procedures outlined in PM01 and analyze in duplicate as a sample. The true value of the spike is calculated as follows:

$$\text{mg/L CaCO}_3 = \frac{\text{Mass}(g)\text{NaHCO}_3}{\text{H}_2\text{O}(L)} \times \frac{100.09}{84.01} \times (1,000,000)$$

4.2.3 Matrix Spike (MS) and Matrix Spike Duplicate (MSD)

- For water samples, MS and MSDs are prepared, analyzed, and reported when clients' request and send sufficient numbers of aliquots to prepare them (e.g. one 40 ml vial each)

for the MS and another for the MSD).

Table 4.2.2

Compound	Vapor LCS/LCSD (ppmv)	Water LCS/LCSD & MS/MSD
Methane	300.0	825 µg/L
Ethane	100.0	45 µg/L
Ethene	100.0	41 µg/L
Propane	100.0	67 µg/L
Propene	100.0	60 µg/L
iso-Butane	100.0	82 µg/L
n-Butane	100.0	85 µg/L
Acetylene	-----	36 µg/L
Carbon dioxide	50,000	130 mg/L
Oxygen	20,000	***
Nitrogen	balance gas	balance gas
Hydrogen	25.00	69 nM
Carbon Monoxide	-----	2.2 mg/L

Notes on Table 4.2.2

- Since oxygen is an ubiquitous “contaminant”, it is not monitored in either the LCS or MS.
- Actual values vary slightly from lot to lot of cylinders of calibration gases.
- MS/MSD prepared by using a standard gas mix instead of He in the headspace prep. procedure.

4.2.3.1 Total Inorganic Carbon MS and MSD

Mix approximately 0.04g NaHCO₃ directly into client samples (when provided and requested), prepare according to the TIC procedures outlined in PM01 and analyze in duplicate as a sample. The true value of the spike is calculated as follows:

$$\text{mg/L CaCO}_3 = \frac{\text{Mass}(g)\text{NaHCO}_3}{H_2O(L)} \times \frac{100.09}{84.01} \times (1,000,000)$$

4.2.4 Method Blank

Method blanks are made up of ultra high purity helium injected into a vial and then into the instrument.

4.2.4.1 Total Inorganic Carbon Method Blank

The method blank for TIC is made up of deionized water in a 40 ml vial, prepared according to the TIC procedures outlined in PM01, and analyzed as a sample.

4.3 Glassware and Storage Requirements for Reagents and Standards

Reagents are stored at room temperature ($70^{\circ}\text{F} \pm 5^{\circ}$) and all standards are prepared fresh for each use immediately prior to each analysis. Standards are made up from compressed gas cylinders. Those standards expire after 2 years.

5.0 Procedure

Water samples should be cooled upon collection and stored at a temperature of just above freezing but below 6°C .

Gas samples are shipped and received at a positive pressure, which eliminates a cross-contamination issue during sample shipment. It is preferable that gas samples be shipped without cooling. However, it is not a sample receipt non-conformance if received vapor samples are packed in ice (sample may experience slight loss in pressure.) Gas samples are stored in the laboratory at room temperature ($70^{\circ}\text{F} \pm 5^{\circ}$). The pressure in gas vials is not checked upon receipt in the laboratory because of the inherent risk of losing sample, or inadvertently introducing atmospheric gases, when the septum is pierced. The number of times the septum is pierced should be as few as absolutely possible. See Section 5.2.2 for a discussion on how the laboratory checks and documents vial pressure. Holding time for both gas and water samples is fourteen days.

Water samples for light hydrocarbon analyses only (methane, ethane, ethane, propane, propene, n-butane, i-butane, acetylene) are collected in 40ml VOA vials with zero headspace and preserved with tri-sodium phosphate (TSP). TSP is added as the dodecahydrate at 200 mg/40 ml vial. This results in a sample $\text{pH} > 10$. Water samples collected for either permanent gases only or permanent gases and light hydrocarbon analyses are collected in 40ml amber VOA vials with zero headspace and preserved with four drops of BAK solution.

Analysts who use this method have been certified for the method by running Initial Demonstration of Proficiency (IDOP) Samples in accordance with Microseeps Standard Operating Procedure for Administering and Documenting Training in Laboratory Procedures and

Instrumentation (SOP ADM 02). IDOPs are run any time there is significant change to an instrument, method, or in the training procedure for training a new analyst.

Because the results from this method frequently require the analyst to use manual integration, manual integration is included as part of the training. Because of the nature of the instrument, the range of interrogated concentrations and the low specificity of the detectors, it is often necessary to perform manual integration even on the laboratory control samples. As part of the training, the analysts must:

- Retain an electronic copy of the original chromatogram that was integrated by the automated settings of the instrument software. (This is done automatically by the chromeleon software.)
- Document on the hard copy Case Narrative a justification for the manual integration and circle "YES" in the box in the lower right corner of the narrative sheet.
- The analyst shall present all the data for review.
- The reviewer shall thoroughly examine the data and when satisfied, check the appropriate box on the case narrative form and place their initials where designated.
- If there are questions about the manual integration, the data reviewer shall review the original chromatogram from the data system.
- If agreement is obtained from the data reviewer that the manual integration was indeed necessary, the reviewer shall document on the same hard copy Case Narrative (lower left corner) that the manual integration was reviewed and the justification stands. If the other criteria of the training are met, the training is deemed successful.
- If the reviewer disagrees with either the necessity of the integration or the specific manipulations done in the integration, the specific objections should be discussed with the trainee and the training should be repeated (4 new samples must be analyzed).

5.1 Sample Preparation

Samples that are collected using the Bubble Strip Sampling Technique, Microseeps Sampling Method SM9, do not require additional preparation prior to analysis.

Samples that are collected as waters and are to be analyzed for dissolved gases (methane, ethane, ethene, acetylene, CO₂, N₂, O₂, propane, propene, iso-butane, n-butane, TIC), must be prepared using Microseeps Standard Operating Procedure PM01G.

Samples that are collected as gases, for example from a soil gas survey or from the headspace of a microcosm sample, need not be collected by a Microseeps sampling method, nor do they require additional preparation.

5.2 Analysis

5.2.1 If the sample is prepared via SOP-PM 01, it can be injected from the gastight syringe in which it is prepared by inserting the needle of the syringe through the septum on the "sample in"

port. If the sample is a calibration standard, a bubble strip sample (SM9), or a gas, the septum inlet to the "sample in" port of the GC must be removed and a luer-lock needle receptacle is plumbed to the "sample in" port in place of the needle. A needle is attached to the luer-lock receptacle and inserted through the septa of the calibration standard, bubble stripped sample, or gas sample.

5.2.2 In order to initiate analysis and introduce the sample into the GC sample loop, a needle is attached to the entry port on the GC and inserted through the sample septum. The flow through the sample loop is monitored by a flow meter connected to the sample-loop vent-port on the gas chromatograph.

When a vial is sufficiently filled, the ball in the flow meter will shoot to the top of the column. This indicates that there is sufficient pressure in the vial to fill the sample loop. If the loop is not properly pressurized, this is reflected on the flow meter immediately. The ball in the flow meter will go up the column part way and drop back to the bottom. This indicates there is not sufficient pressure in the sample vial. If this happens, the analyst will remove the vial from the inlet port as quickly as possible and withdraw 10 – 12ccs of sample from the sample vial using a locking syringe. This is then injected into the instrument. The lack of sufficient pressure in the vial and the means of sample injection are then documented on the case narrative.

5.2.3 Once the flow out of the sample loop ceases (3 seconds if SOP-PM 01 is used) the sample loop valves are activated.

5.2.4 Once the sample loop valves are activated, the ports to and from the sample loop are flushed with ultra high purity helium injected into the loop directly from the cylinder to remove any interference from ambient air and to avoid cross contamination between samples.

5.3 Calibration and Results

5.3.1 The standard calibration gas should be introduced in the same manner as described in section 5.2.1 above. Measured peak areas are converted to concentrations using certified commercial gas standards. Dilutions are made to achieve multi-point calibration curves for each detector.

5.3.2 Initial calibration is accomplished by analyzing multiple standards of appropriate calibration ranges.

Note: Due to the nature of preparing custom gas standards, the component concentration can fluctuate between purchased lots. This is accounted for during method/calibration development. These results will be used to establish a multi-point calibration curve.

Acceptance Criteria: A linear fit to an area response versus concentration plot is formed with the origin forced to zero, and the calibration is accepted for use if r^2 , the coefficient of

determination is ≥ 0.995 . If this criterion can not be met using a linear fit, a quadratic can be used. For the quadratic fit, the acceptance criteria is also $r^2 \geq 0.995$.

Corrective Action: If the acceptance criteria specified above is not met, the reason is determined and a new set of calibration standards are analyzed.

5.3.3 An Initial Calibration Verification (ICV) standard immediately follows the initial calibration. Acceptance criterion for the ICV is an instrument response within $\pm 15\%$ drift. Since the instrumentation used at Microseeps routinely monitors the percent recoveries and in this instance percent drift is equal to percent recovery less 100%, the control limits are 85%-115% recovery for the ICV.

$$\text{Percent Recovery} = \frac{\text{Measured Value}}{\text{True Value}} \times 100\%$$

Acceptance Criteria and Corrective Action: If the instrument response for the ICV standard is outside the acceptance window of 85-115%, the analyst will not analyze samples until either the reason is determined and the problem is corrected, or a new multi-point calibration is analyzed and an acceptable ICV is run using that calibration.

5.3.4 An initial calibration blank follows the ICV. The blank is made up of the carrier gas. Compounds must not be detected above the reporting limits. For DoD projects the results of the ICB must be $< \frac{1}{2}$ RL.

Corrective Action: If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.

5.3.5 The analytes of this method are indicators. Every attempt to achieve and deliver precise results is made. However, it is realized that for indicator parameters measuring the range of the analyte concentration (*i.e.* is the concentration of methane gas >1 mg/l or < 0.1 mg/l) is the primary goal of employing these analyses. The calibration range is chosen to extend over most of the bio-indicator concentration range. If the concentration of an analyte exceeds that of the highest calibration standard, but does not saturate the instrument response, the concentration is calculated by assuming detector response linearity and using an extrapolation of the calibration plot. If the instrument response is saturated the sample is diluted to bring the analyte concentration into the calibration range.

5.4 Quality Control

The following quality control samples shall be analyzed with each analytical batch of fifteen or fewer samples.

5.4.1 A Continuing Calibration Verification: The CCV is made up from a source other than what was used to make up the initial calibration. The acceptance criterion for the CCV is a

percent recovery of 85-115%. The CCV is also analyzed at the beginning and end of each analytical shift and after every 15 samples.

Corrective Action: If the CCV fails, a new CCV is prepared and analyzed. If the new CCV falls within the acceptance criterion, analysis continues. If the new CCV fails, the instrument shall be recalibrated, and all samples since the last acceptable calibration verification shall be reanalyzed, provided sufficient sample volume is present and the samples have not been compromised by exposure to air.

5.4.2 A Continuing Calibration Blank: A CCB follows each CCV. The blanks are made up of the carrier gas. The acceptance criterion for the blank is the result must be less than the reporting limits for all compounds. For DoD projects the results for the CCB must be < ½ RL.

Corrective Action: If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.

5.4.3 Laboratory Control Sample and Laboratory Control Sample Duplicate: The LCS and LCSD are prepared and analyzed at a mid-calibration range. Both an LCS and an LCSD are to be run with each batch.

Acceptance Criteria: Percent recovery is required to be between 80-120%, inclusive. An acceptance criterion is based upon the percent recovery and the RPD as calculated by:

$$\text{Percent Recovery} = \frac{\text{Measured Value}}{\text{True Value}} \times 100\%$$

$$\text{RPD} = \frac{|C1 - C2|}{\frac{C1 + C2}{2}} \times 100\%$$

Where: C1=LCS
C2=LCSD

RPD (Relative Percent Difference) is required to be less than or equal to 20%.

Corrective Action: If the LCS fails, a new LCS is prepared and analyzed. If the new LCS falls within the acceptance criterion, analysis continues. If the new LCS fails, analysis is stopped and the instrument is checked with a series of standards to determine the cause. Once the cause is determined and the instrument repaired, calibration is conducted and analysis continues.

5.4.4 Matrix Spike and Matrix Spike Duplicate: Matrix spikes and spike duplicates are analyzed for water samples only when requested by a client and sufficient sample aliquots are provided. Acceptance criterion is a percent recovery between 70% and 130% and a relative percent difference (RPD) of less than or equal to 20%.

Corrective Action: If the matrix spike and spike duplicate fail but all the other quality control samples are within the acceptance criteria, matrix interference is noted in the Case Narrative.

5.4.5 Method Blank: A method blank is analyzed with each sample batch. The blanks are made up of UHP helium for all of the gases except for blanks for TIC. TIC blanks are made up of deionized water. The acceptance criterion for the blank is the result must be less than the reporting limits for all compounds. For DoD projects the results for the method blank must be $< \frac{1}{2}$ RL.

Corrective Action: If the blank does not meet the acceptance criterion, another blank is injected until the results are within the acceptance criterion.

5.4.6 Contingency for Handling Out of Control or Unacceptable Data

If the requirements set forth in section 5.4 are not met, the analytical program will be terminated until the cause is determined and a solution is affected. All samples associated with out of control quality control samples (with the exception of matrix interference) must be reanalyzed provided another vial of sample has been provided by the client. If quality control acceptance criteria cannot be met using the corrective action above, a detailed check of the analytical system is made. Reagents, standards, and other quality control samples are re-prepared and analyzed. If problems persist, sample analysis will be halted and the Laboratory Manager shall be contacted immediately to determine the cause and implement corrective action.

Any data submitted with unacceptable quality control sample results shall be qualified in a case narrative. The narrative should indicate the out of control event that occurred, the corrective action that was taken, and any other pertinent information to inform the client of exactly what occurred.

5.4.7 An experienced analyst shall examine all chromatograms.

5.4.8 Through out analysis the gas samples are injected mechanically into the GC flow path utilizing a sample loop to achieve a uniform sample size from a flow directly from the sample preparation syringe. The uniform sample size achieved using the sample loop assures consistent and accurate results. Table 5.4.8 (see next page) gives example data from a study performed via this analysis. That data can also be used for accuracy and precision estimates.

Table 5.4.8
Example Data for Precision and Accuracy Studies

	Carbon Dioxide	Oxygen	Nitrogen	Methane	Hydrogen	Methane	Ethane	Ethylene	Propane	Propylene	Iso-Butane	N-Butane
REP. #	(% v)	(% v)	(% v)	(% v)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)	(PPMV)
1	0.1221	0.0670	0.5744	0.0410	0.1118	0.2512	0.0525	0.0453	0.0461	0.0581	0.0473	0.0358
2	0.1267	0.0690	0.6020	0.0428	0.1122	0.2608	0.0518	0.0468	0.0521	0.0465	0.0439	0.0407
3	0.1207	0.0657	0.5838	0.0446	0.1247	0.2812	0.0509	0.0485	0.0529	0.0588	0.0436	0.0405
4	0.1193	0.0667	0.6036	0.0444	0.1244	0.2779	0.0549	0.0460	0.0461	0.0536	0.0549	0.0476
5	0.1261	0.0703	0.5860	0.0439	0.1120	0.2894	0.0551	0.0497	0.0520	0.0549	0.0417	0.0460
6	0.1193	0.0665	0.5861	0.0478	0.0943	0.2970	0.0515	0.0467	0.0458	0.0542	0.0435	0.0514
7	0.1227	0.0732	0.5748	0.0353	0.1296	0.3053	0.0532	0.0473	0.0485	0.0584	0.0483	0.0535
AVERAGE	0.1224	0.0683	0.5872	0.0428	0.1156	0.2804	0.0528	0.0472	0.0491	0.0549	0.0462	0.0451
KNOWN	0.1500	0.0700	0.6649	0.0450	0.0999	0.1500	0.0500	0.0500	0.0500	0.0500	0.0500	0.0500
STD. DEV.	0.003	0.003	0.012	0.004	0.012	0.019	0.002	0.001	0.003	0.004	0.004	0.006

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5.4.9 The gas matrix for this analysis minimizes the opportunity for matrix effects. If the gas is prepared from a matrix other than that which is injected into the GC (*e.g.* prepared through headspace extraction via Microseeps SOP-PM01), the client should request that matrix spike (MS) and matrix spike duplicate (MSD) analyses be conducted and should supply sufficient sample volume. Since matrix effects are extremely site dependent, the MS and MSD are not part of the regular analytical quality assurance program.

5.4.10 All of the target analytes gases are at room temperature so the opportunity for carry over is small. This is further reduced by the flushing of the sample loop, by the “backflush” configuration of the GC plumbing, and by the nightly bake-out procedure. These combine to keep carry-over concentrations to less than half of the reporting limits.

5.5 Capturing and Submitting Data

The output of the chromatograph is directed to a microcomputer where the signal is converted to digital format, stored, and processed using a chromatography data system.

Automated valve control: Digital control is provided by the microcomputer through the chromatography data-system software. This control provides constant start and stop times for directing carrier gas flow. The event times are programmed and saved using the method editor module of the software.

5.5.1 Total Inorganic Carbon Result Calculation

The total inorganic carbon result is calculated as follows:

$$\text{TIC as mg/L CaCO}_3 = (\% \text{CO}_2) \times (\text{Volume headspace}) \times (2.08) + 43.3$$

This analysis produces concentration of the analyzed gas in % V.

5.5.2 Retention Time Windows

Retention time studies have been conducted for this analysis. These studies are kept on file in the Quality Systems Office. The exact retention times will vary as a function of column type, column age, and column history. For the instruments that use this method, true retention times and retention time windows are taken from the most recent standard analyzed.

5.5.2.1 Determination of Retention Time Windows

Inject a standard a total of 3 times over a 72 hour period. Record the retention time for each component to a minimum of 3 decimal places. Calculate the mean and standard deviation of the three absolute retention times for each component. If the standard deviation for a target compound is 0.000, use a default standard deviation of 0.01 minutes. The width of the retention time window for each analyte is ± 3 times the standard deviation of the mean absolute retention

time. If the default standard deviation 0.01 minutes is used, the width of the window will be 0.03 minutes.

Establish the center of the retention time window for each analyte by using the absolute retention time for each analyte from the calibration verification standard at the beginning of the batch.

Retention time windows must be calculated for each instrument and column used. New retention time windows must be established when a new column is installed.

5.6 Bake-out Procedure

Either overnight, through the weekend or whenever the instrument is not going to be used for several hours, the instrument is put in “bake-out”. With carrier gas continuous flushing through the GC, the temperature on the oven is manually turned up to 210 degrees or as high as the instrument column oven can maintain.

6.0 Secondary Data Review

All analytical data must undergo a minimum of a two-tiered review. The analyst first reviews the data for completeness and accuracy. The data is then submitted to the Group Lead Analyst for final review and the data is entered into the LIMS. Once approved at this level, the data is uploaded into the LIMS.

7.0 Reporting Limits

The reporting limits for this analysis are listed in Table 7.0 below. Method detection limit studies are run annually in accordance with Microseeps Standard Operating Procedure for the Determination of Method Detection Limits and PQLs (SOP-ADM 18).

Those MDLs must be less than the reporting limits specified below. MDL studies are also performed when there is reason to suspect that method sensitivity has changed. The MDL studies are kept on file in the Quality Systems Office.

Reporting Limits
Table 7.0

Parameter	Reporting Limit	Units
Carbon Dioxide	0.2	% V
Oxygen	0.1	% V
Nitrogen	0.1	% V
Hydrogen	0.5	ppmv
Parameter	Reporting	Units

	Limit	
Acetylene	0.1	ppmv
Methane	0.2	ppmv
Ethane	0.02	ppmv
Ethene	0.03	ppmv
Propane	0.05	ppmv
Propene	0.1	ppmv
n-Butane	0.07	ppmv
i-Butane	0.05	ppmv

7.1 Conversion Factors

This procedure is used to measure the volume concentration of the analytes in a gas. Two methods are used to extract that gas from the groundwater. The conversion factors that are used to convert the concentration of the analytes in the water from the concentration of the analytes as they are measured using this method, are specific to the collection or preparation method and can be found in either SOP-SM9 or SOP-PM 01.

8.0 Safety

Gloves, proper eye protection, and a laboratory coat shall be worn when handling samples and standards. The major hazard in this laboratory area is stick from needles. All needles must be capped when not in use and when moving about the laboratory. The proper way of capping a needle is to place the cap on the laboratory bench and direct the needle into the cap. A needle is never to be directed into a cap while the cap is being held.

All compressed gases are to be moved using a dolly made for transporting gases and shall be chained in place when in the laboratory. The chain shall be tightened sufficiently to keep the cylinder upright if jostled.

9.0 Laboratory Waste

Samples are kept for 30 days following analysis. Samples are disposed according to Microseeps Standard Operation Procedure for Waste Disposal (SOP-ADM 14).

9.1 Waste Minimization

Where possible, Microseeps takes steps to minimize the amount of waste generated in the laboratory by using substitution, where possible, and good chemical handling procedures. For specific information on waste minimization consult SOP-ADM 14.

10.0 References

Citing a reference does not imply that all of the recommendations and/or requirements in those cited methods is required in this Standard Operating Procedure. This section simply refers to sources that were consulted to gather information or knowledge in order to write an informed technical procedure.

U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste. SW-846, 3rd ed., Office of Solid Waste and Emergency Response, Washington, DC. 1986.

Newel, B.S., RSK-SOP-175, Sample Preparation and Calculations for Dissolved Gas Analysis in Water Samples using GC Headspace Equilibration Technique. Revision No. 0, August 1994.

American Society for Testing and Materials, Standard Practice for Analysis of Reformed Gas by Gas Chromatography. Annual Book of ASTM Standards. Vol. 14.02, 1994.

Kampbell, D.H. and Vandegrift, S.A., Analysis of Dissolved Methane, Ethane, and Ethylene in Ground Water by a Standard Gas Chromatographic Technique. Journal of Chromatographic Science. Vol. 36, May 1998.

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**VOLATILE ORGANIC COMPOUNDS
by GC/MS**

In Soils, Solid Waste, Surface & Ground Water by EPA 8260B and 8260C
and in Wastewater by EPA 624

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VOLATILE ORGANIC COMPOUNDS by GC/MS
In Solid Waste, Surface Water & Ground Water by EPA 8260B
And in Wastewater by EPA 624

SCOPE

This document describes the procedure for purging volatile organic compounds (VOC) from liquid and solid matrices, separating them by gas-chromatography, and quantifying them by mass-spectrometry. This procedure may be used to quantitate halogenated VOC's (previously listed in EPA 8010), aromatic VOC's (previously listed in EPA 8020), ketones, gasoline oxygenates, and other compounds which are insoluble or only slightly soluble in water.

EPA 8260 was written by the EPA's Office of Solid Waste with additional guidance for surface water and ground water, as opposed to EPA 624 which was written by the EPA's Office of Water specifically for wastewater. EPA 624 may also be requested for groundwater samples if the client is planning to discharge the water, with or without additional treatment, into a wastewater stream or into naturally occurring surface waters (bay or river). See [Appendix 16](#) for EPA 624 requirements.

For the common target compounds, reporting limits range from 0.5 ppb to 20 ppb. See [Appendix 10](#) for compound list and specific reporting limits.

REFERENCES

Analysis Methods:

EPA 8000B, Determinative Chromatographic Separations, USEPA SW846 Update 3, 1996
EPA 8000C, Determinative Chromatographic Separations, USEPA SW846 Update 4, 2003
EPA 8260B, Volatile Organic Compounds by GC/MS, USEPA SW846 Update 3, 1996
EPA 8260C, Volatile Organic Compounds by GC/MS, rev 3, August 2006
EPA 624, Purgeable Organics, 40CFR136 Appendix A
40CFR MUR (4/11/07), Federal Register, Part III, March 12, 2007

Sample Prep Methods:

EPA 5000, Sample Preparation for VOCs, SW-846 Update 3, December 1996
EPA 5030B, Purge & Trap for Aqueous Samples, SW-846 Update 3, December 1996
EPA 5030C, Purge & Trap for Aqueous Samples, rev 3 May 2003
EPA 5035, P&T and Extraction for VOC's from Soil and Wastes, SW-846, Update 3, Dec 1996
EPA 5035A, P&T and Extraction for VOC's from Soil and Wastes, 2003
EPA 624, Purgeable Organics, 40CFR136 Appendix A

Additional SOP's and Guidance Documents:

QA SOP 1.4, *Balance Calibration Check & Maintenance*
QA SOP 1.5, *Calibrating & Maintaining Temperature Controls*
QA SOP 1.6, *Pipet Calibration Check Procedures*
QA SOP 4.1, *Establishing Control Limits*
QA SOP 4.4, *Determining Method Detection Limits (MDL)*
QA SOP 8.4, *State Program Requirements*
QA SOP 8.5, *Federal Program Requirements*
QA SOP 9.6, *Insuring Compliant Manual Integration*
CS SOP 2.3, *Subsampling & Compositing (ASTM D6323-98, Lab Subsampling of Media Related to Waste Management Activities, Reapproved 2003)*
NELAC Chapter 5, *Quality Systems*, June 2003

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DoE Quality Systems Manual, Version 2.2, October 2006
Operator Manuals for "Target" software and operating system
Operator Manuals for EST and Tekmar Purge & Trap systems
Operator Manuals for HP5890, HP6980 & Agilent 6890 GC's
Operator Manuals for HP5972, HP6890 & Agilent 5975 MSD's
Operator Manuals for Agilent Chemstation Software
Volume 1, TNI Standard, EL-V1-2009, September 2009
DoD Quality Systems Manual, Rev 4.2 October 2010

PRESERVATION & HOLDING TIMES

Water Samples:

Preservation: HCl to pH < 2.
Holding Time: Store at 4°C. Analyze within 14 days.

If a client submits unpreserved VOAs for the full 8260 list, Gasoline Oxygenates, or 8020MS list, the samples must be analyzed within 7-days. If the unpreserved samples are to be analyzed only for halogenated volatiles (8010MS list), the samples must be analyzed within 14-days.

If 2-Chloroethylvinylether is included in the client's compound list, the client should have submitted unpreserved VOA vials. If these samples are submitted only for the Halogenated VOC list (LIMS product '8010MS') the holding time is still 14 days. If the samples require the full 8260 list, the holding time is reduced to 7 days.

Free chlorine should be neutralized at the time of sampling by addition of 0.008% sodium thiosulfate ($\text{Na}_2\text{S}_2\text{O}_3$). Because the VOA vials are not opened until after analysis, when the sample pH is verified, C&T does not check for residual chlorine; any residual chlorine would likely have dissipated into the headspace after analysis.

Soil Samples:

in brass sleeves: Store at 4°C
Analyze within 14 days of sampling date.

in Encore devices: Store at 4°C & analyze within 48-hours, *or*
Preserve with sodium bisulfate within 2 days & analyze within 14 days, *or* preserve with methanol within 2 days & analyze within 14 days, *or* Freeze* & analyze within 7 days.

If sampled into a pre-weighed, documented, 40mL VOA vial with 5mL DI water, frozen within 48-hrs, analyze within 14 days

* *Method Modification:* Region 9 has approved the use of freezing to extend the holding time for unpreserved samples to 7 days, however the client must approve this variance on a case-by-case basis. A copy of the USEPA Region IX Interim Policy Memorandum (June 23, 1999) is on file in the QA files.

Methanol Extracts: Store at 4°C. Analyze within 14 days of *sampling* date.

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Reagents: Label MeOH bottle with date opened and either use or discard within one year.

QC REQUIREMENTS

A Method Blank (MB) must be analyzed for each batch of 20 or fewer samples, with additional blanks run for each twelve-hour shift if a batch is run over more than one tune shift. For aqueous samples, the method blank is organic-free Ultrafiltered deionized water. For low-level soil samples, the method blank used is 5mL Ultrafiltered deionized water. For medium-level soil and waste samples extracted into methanol, the method blank is Ultrafiltered DI water and the prep blank is the same methanol lot used in the extraction. For TCLP leachates, the method blank is Ultrafiltered DI water and the prep blank is the TCLP extraction fluid used to extract the samples. For methanol and TCLP extracts, the prep blank must be analyzed once and a method blank must be analyzed in each 12-hour tune-shift in which the extracts are analyzed.

A Laboratory Control Sample (LCS) must be analyzed with every batch of twenty or fewer samples of a given matrix. Following DoD guidance, sporadic marginal failures are allowed for 5% (3 compounds) of the standard 8260 target compound list, except that C&T requires those compounds listed in EPA 5000 Section 5.5.1 to pass acceptance criteria. If any of the EPA 5000 compounds or more than 3 of the remaining compounds fails acceptance criteria, initiate a corrective action record.

A matrix spike (MS) and matrix spike duplicate (MSD) should be analyzed with every batch of twenty or fewer samples of a given matrix type. If insufficient sample volume was submitted for an MS and MSD, a blank spike (BS) and blank spike duplicate (BSD) may be analyzed in place of the LCS/MS/MSD.

Surrogates and Internal Standards are added to every sample, blank, spike, and calibration standard. See associated SOP *EPA 8260 Laboratory Control Limits, Table-1* for in-house spike and surrogate QC limits which are updated every 6 months, based on control-charts of the previous years data.

An initial calibration curve consisting of a minimum of 5-points must be established for each compound; an Initial Calibration Verification (ICV) standard must be analyzed immediately after calibration standards to verify the curve. Sample results associated with a failing initial calibration cannot be reported. See [Appendix 9](#) for details.

A BFB tune standard and Continuing Calibration Verification (CCV) must be analyzed at the beginning of each 12-hour shift to verify that the initial calibration curve is still valid. Sample results associated with a failing BFB cannot be reported. See [Appendix 8](#) for determining the usability of data associated with failing CCV criteria.

A method detection limit study consisting of at least 7 laboratory control samples with low analyte concentrations will be extracted and analyzed; see the QA SOP "Method Detection Limits" for details. A Limit of Detection (LOD) must be determined quarterly and is based on a laboratory control sample that is spiked 2 to 4 times the MDL, extracted and analyzed on every instrument. See the QA SOP for Method Detection Limits for details. A limit of quantitation (LOQ) must be determined quarterly and is based on a laboratory control sample that is spiked 1 to 2 times the reporting limit. It is only analyzed once per method. See the QA SOP of Limit of Quantitation for details.

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NOTE: DoD QSM 4.1 projects and other Quality Assurance Project Plans (QAPPs) submitted by C&T clients may include different acceptance criteria for calibrations and batch QC such as ICAL, ICV, CCV, LCS, method blanks, MS/MSD, and surrogate recoveries etc. For samples associated with those projects, the requirements detailed in the QSM 4.1 or QAPP supersede this SOP. LIMs will transmit all client specific criteria to the analyst prior to sample analysis and evaluate sample results to these criteria.

SAFETY

Assume that all samples, standards, and extracts contain toxic and/ or potentially hazardous chemicals. Lab gloves and safety glasses should be worn whenever handling samples, standards, or extracts.

EQUIPMENT (Refer to Appendix_6 for specific [instrument configurations](#))

Autosamplers:

Tekmar AquaTek70 Autosampler / Velocity XPT Concentrator
Tekmar AquaTek70 Autosampler / 3100 Concentrator
Tekmar SolaTek72 Autosampler / 3100 Concentrator
EST Archon 8100 Autosampler / Encon Concentrator

Gas Chromatographs:

HP Model 5890
Agilent Model 6890
Electronic Pressure Control

Columns:

Restek Fused Silica Capillary Column, 60m x 0.32mm x 1.5 μ m, Rtx-Volatiles
Restek Fused Silica Capillary Column, 60m x 0.25mm x 1.4 μ m, Rtx-624
J&W Fused Silica Capillary Column, 60m x 0.25mm x 1.4 μ m, DB-624
Agilent Fused Silica Capillary Column, 20m x 0.18mm x 1 μ m, DB-VRX
Other columns may be used at the analyst's discretion.

Mass Spectrometers:

HP Models 5970 and 5972
Agilent Model 5973
Agilent Model 5975

Software & Hardware:

Agilent Chemstation Software
Windows NT server with Target software

DAILY INSTRUMENT SEQUENCE

Each sequence must begin with a BFB Tuning standard followed by a Continuing Calibration Verification (CCV) standard. Once the tune and CCV have passed acceptance criteria, samples may be added to the instrument sequence. An example of a typical instrument sequence is presented below. All samples (and associated batch QC) must be injected within 12 hours of the associated BFB injection time. Approximately 18-20 runs can be completed within the 12 hour period. An example of a typical sequence is presented below:

BFB (begins the 12 hour clock)
CCV standard
LCS (one per batch of twenty samples per matrix)
Method Blank

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Samples
 MS (one per batch of twenty samples per matrix)
 MSD (one per batch of twenty samples per matrix)

BFB (re-starts the 12 hour clock)
 CCV standard
 Method Blank
 Samples

All standards and samples loaded on the instrument should be recorded digitally through the data acquisition software and on an instrument run log as a reference. For methanol extracts, the extraction information should be recorded in the methanol extraction log notebook.

Aqueous samples, leachates, and dilutions of methanol extracts may be analyzed in water mode. TCLPs and Methanol Extracts can be run in Soil mode. If low reporting limits are required for methylene chloride, then water mode must be used since the vial is not opened in the lab and less contamination is introduced than in soil mode.

Water-mode calibrations and samples are not heated during the purge cycle. Soil-mode calibrations and samples are heated at 40°C during the purge cycle.

Data File Naming Conventions

Because the original data acquisition software had file names with a maximum field length of 6 characters, C&T file names use abbreviated codes for the instrument ID and date. The instrument ID, month, and day codes are outlined below. Data files are named as:

IMD## where I = Instrument ID, M = Month, D = Day, ## = Run Number (01 through 99).

Instrument	Designator	Instrument	Designator
MSVOA02	B	MSVOA09	I
MSVOA04	D	MSVOA10	J
MSVOA05	E	MSVOA11	K
MSVOA06	F	MSVOA12	L
MSVOA07	G	MSVOA13	M
MSVOA08	H	MSVOA14	N

Month	Designator	Month	Designator
January	A	July	G
February	B	August	H
March	C	September	I
April	D	October	J
May	E	November	K
June	F	December	L

Day	Designator	Day	Designator	Day	Designator
1	1	11	B	21	L
2	2	12	C	22	M
3	3	13	D	23	N
4	4	14	E	24	O
5	5	15	F	25	P

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6	6	16	G	26	Q
7	7	17	H	27	R
8	8	18	I	28	S
9	9	19	J	29	T
10	A	20	K	30	U
				31	V

Example: The 2nd run on instrument MSVOA04 on September 28 would be named DIS02 (instrument D, September, 28th, run 02).

Writing a Chemstation Sequence

Various user reports are automatically produced after the run is complete. This automation is based on the type of sample being analyzed, the sample number, the LIMS identification of any associated calibration or spiking standards, the batch number, and any applicable dilution factors. This data must be correctly entered into the sequence in a specific order for LIMS to be able to interpret the information and should be written into the sequence as follows:

BFB, S#, 50ng
CCV, S_a#, Vs/Vf_a, S_b#, Vs/Vf_b, Conc
LCS, QC#, Batch#, Vs/Vf, S_a#, IDF_a, S_b#, IDF_b
IB, NP
MB, QC#, Batch#, Vs/Vf
S, Samplenum, Batch#, Vs/Vf
MS, QC#, Batch#, Vs/Vf, S_a#, IDF_a, S_b#, IDF_b,
MSD, QC#, Batch#, Vs/Vf, S_a#, IDF_a, S_b#, IDF_b,

Where:

Conc is the concentration of the standard (ie: 50ppb)

IDF is the dilution factor for the standard, written as "1000x" or similar, as an alternate to Vs/Vf

NP means "No Print" the compound spectra

Samplenum is the LIMS sample number (ie: 160961-005)

Vs is the volume/ weight (in mL or g) of standard or sample used,

Vf is the final volume of the standard or sample,

(ie: Vs/Vf = 0.02/100 for 20µL to 100mL of a standard, or Vs/Vf = 1/1 for an undiluted sample),

S# is the LIMS S# of the standard used,

If the MS and MSD use the same working standards and volumes as the LCS, the information may be written as: MS, QC#, Batch#, Vs/Vf, =LCS

Similarly, the CCV for the 2nd tune-shift can be written as: CCV, =CCV

1.) Tuning: (See Appendix_8 for [BFB acceptance criteria](#))

The MS-detector must be tuned to meet specific performance criteria so that data produced by this instrument will be comparable to that produced by another. *All samples (including QC) and calibration standards must be injected within 12 hours of the injection time of the associated, acceptable BFB tune standard.* Samples or QC desorbed outside the 12-hour clock cannot be reported. Once a BFB tune standard (conc. 25-50 ng/ul) is injected into the system, any previous 12-hour shift is no longer valid and the injected BFB tune standard must meet its specific performance criteria before samples can be run.

- 1.1) Start the daily 12-hour tune shift sequence (or 2nd 12-hour tune shift) by analyzing the BFB, prior to analysis of the calibration verification standards and samples. Use the method BFBS<#>8.m, where # is the instrument number.
 - 1.2) See [Appendix 2](#) for instructions on preparing the 50ng aliquot of BFB (4-Bromofluorobenzene).
 - 1.3) After the BFB has run, the software will automatically generate a report comparing the BFB mass spectrum to the performance criteria specified in EPA 8260B (see [Appendix 8](#)), using the average of three scans centered at the apex, with background subtraction. Because method 8260B also allows a single scan at the apex (or one scan to the left or right of the apex) or the average of two consecutive scans (including one at the apex), the analyst may manually process the tune using one of these six scenarios if the average of the three scans does not meet criteria. The tune report will indicate which scans were used. If the BFB fails acceptance criteria, the failing range will be flagged with an asterisk. If no asterisk appears on the report, the BFB meets tune criteria; continue by preparing and analyzing a CCV.
 - 1.4) If the BFB fails criteria (listed in [Appendix 8](#)), inspect the data to determine if the tune standard should be re-analyzed, the instrument re-tuned, or whether maintenance (e.g., source cleaning) may be necessary. A tune standard may be reanalyzed once but if the 2nd tune standard also fails, the instrument should be re-tuned or additional instrument maintenance performed - do not simply reanalyze the standard until one passes. *Sample results associated with the failing 12-hour BFB tune-shift cannot be reported.*
- 2.) Continuing Calibration Verification (CCV) Standard:** (See [Appendix 8](#) for [CCV criteria](#))
After a BFB run passes tune criteria, analyze a Continuing Calibration Verification (CCV) standard to verify that the response of the instrument has not changed and that the initial calibration curve may still be used to quantitate sample results. This calibration standard must be analyzed at the beginning of each 12-hour shift, after the BFB tune standard but prior to any samples or batch QC.
- 2.1) Decide what concentration CCV standard to analyze, keeping in mind that the concentrations must be alternated across the mid-levels of the calibration curve (NELAC requirement).
 - 2.2) See [Appendix 2](#) for instructions on [preparing the CCV](#) standard.
 - 2.3) Analyze this standard using the same data acquisition method as for the samples, typing "CCV," before the working standard number, so that LIMS will automatically generate a Form 7 (Continuing Calibration Verification summary), which compares the response factors from this standard to those of the initial calibration curve.
 - 2.4) Examine the CCV results against the following criteria:

- a.) The retention times should increase with assigned 'compound number' (in the acquisition software). The compound spectra should be re-examined for any Rt's that appear out of order.
- b.) All compounds must meet minimum relative response factor (RRF) of 0.05.

Note: Method 8260C specifies minimum RRF for many target compounds. For compounds with high RL's, the minimum RRF is 0.05 divided by that compounds RL. Thus for a compound with a reporting limit of 10ug/L (example: tert-Butyl alcohol), the minimum RRF is 0.005.

- c.) System Performance Check Compounds (**SPCC's**) RRF must be:

RRF \geq 0.3 for: Chlorobenzene 1,1,2,2-Tetrachloroethane

RRF \geq 0.1 for: Chloromethane 1,1-Dichloroethane
Bromoform

- d.) Calibration Check Compounds (**CCC's**) percent difference (or percent drift if the compound was calibrated using linear regression) from the initial calibration must be \leq 20%.

%D \leq 20 for: Vinyl Chloride 1,1-DCE
Chloroform 1,2-Dichloropropane
Toluene Ethylbenzene

- e.) **Non-CCC** compounds must have %D \leq 20% for compliance to DoD QSM and 8260C. Compliance for 8260B requires %D \leq 30% and allows %D \leq 40% for compounds known to be "bad actors".

EPA 624 Method Note: EPA 624 does not discuss minimum response requirements or differentiate between various types of analytes. The recoveries must meet those listed in Table 5 of the method, however the criteria listed in a.) through e.) above are tighter than those listed in the method and should be used for routine analysis.

- 2.5) Examine the integration in the data analysis software for every analyte to verify that each peak was correctly integrated. Manual integrations must be consistently applied to ICAL, CCV's, and sample integrations.

Unsubstantiated alteration of peak integration solely to pass calibration or QC criteria is illegal and is grounds for immediate termination.

- 2.6) If the SPCC and CCC criteria are not met, another CCV standard should be analyzed, unless reporting a single analyte or small set of analytes. In these cases, those target analytes must each pass SPCC and CCC criteria. If the second analysis of the standard fails to meet all SPCC and CCC criteria, recalibration and/or other instrument maintenance is required.

If two CCV's were analyzed, "x" out the first CCV, set the second to stype "CCV" and process the data from the second CCV. Do not "cherry pick" some compounds from the first CCV and others from the second CCV; if the second CCV is processed and used, all compounds must be taken from the second standard.

- 2.7) If the SPCC and CCC criteria are met, but other compounds fail acceptance criteria, data may be reportable based on the following criteria:
- a.) If the failing compound is not a target analyte for the associated samples, sample results should be reported without reanalysis. No narration is required because the compound is not required for those samples.
 - b.) If the compound fails the minimum RRF (0.05) requirement and is a required target compound for the associated samples, the samples must be reanalyzed.
 - c.) If the compound fails the %D criterion due to a high response but was not detected above the reporting limit in the associated samples, the sample results may be reported without reanalysis, as the high bias does not affect the sample results.
 - d.) If the compound fails the %D criterion due to a high response and was detected above the reporting limit in any of the associated samples, the samples must be reanalyzed.
 - e.) If the compound fails the %D criterion due to a low response but met the minimum response requirement (0.05 RRF), was low by no more than 50%, and was not detected in the sample at any level, the sample results may be reported without reanalysis unless the job is for a DOD level III client in which case the samples must be reanalyzed.
 - f.) If the compound fails the %D criterion due to a low response and was detected (even below the reporting limit), the sample must be reanalyzed.

See Appendix_1 for calculation of %D and the relative response factor (RRF).

3.) Laboratory Control Sample (LCS):

A Laboratory Control Sample (LCS) containing all target compounds is analyzed immediately before the method blank. The LCS must be analyzed for every batch of twenty or fewer samples of similar matrix, to demonstrate the accuracy of the analysis in the absence of matrix interferences. The LCS should be spiked between the low and middle level of the instrument's calibration.

- 3.1) *Soil Mode*: Spike 5mL reagent water in a labeled VOA vial with 1 µL each of SU-ICV250, S-ICVGAS250, and ICVGASOX, and surrogates including TFT.

If running the LCS as the CCV, the spike level must be varied. Use a 5uL syringe and spike according to the table below.

SOIL MODE					
Standard Conc. (µg/Kg)	Add Vol (µL) SU-ICV250	Add Vol (µL) SU-ICVGASOX	Add Vol (µL) SU-ICVGAS250	Add Vol (µL) VOANTICV	Final Volume (mL)
25	0.5	0.5	0.5	0.5	5
50	1.0	1.0	1.0	1.0	5

Note: An alternative way to prepare the CCV or LCS to be run in soil mode is to first prepare the standards following the table below for water mode, then pour them into a clean-rinsed 5mL gas-tight class-A volumetric syringe. Transfer 5mL from the syringe into the empty labeled VOA vial.

Water Mode: To make a 25 µg/L LCS, spike a 100mL volumetric filled with reagent water with 10 µL each of SU-ICV-250, S-ICVGAS250, and ICVGASOX. Invert three times and pour into two VOA vials, leaving no headspace. If more than two vials are needed, a larger volumetric may be used with the appropriate amount of spike added. If running the LCS as the CCV, use the table below to determine spike amounts.

WATER MODE					
Standard Conc. (µg/Kg)	Add Vol (µL) SU-ICV250	Add Vol (µL) SU- ICVGASOX	Add Vol (µL) SU-ICVGAS250	Add Vol (µL) VOANTICV	Final Volume (mL)
20	8	8	8	8	5
25	10	10	10	10	5
30	12	12	12	12	5

TCLP Leachates: Leachates may be run in either soil or water mode. Use the volumes above but substitute the TCLP blank fluid for the DI water.

Note: EPA 8260B Section 5.13.2, specifies the spiking standards must be from a different source than the ICAL standards.

- 3.2) Analyze the LCS using the same data acquisition method as for the samples, typing "LCS," before the QC-number.
- 3.3) Review the LCS run and results before loading the rest of the sequence; the LCS must pass the following acceptance criteria for associated samples to be reported.

SW-846 Method 5000, Section 5.5.1 defines required spike compounds as the following:

1,1-Dichloroethene	Trichloroethene	Chlorobenzene
Benzene	Toluene	

Sporadic marginal failures are allowed for 5% (3 compounds) of the target 8260 and GASOX compounds, except that the compounds listed in EPA 5000 Section 5.5.1 must pass acceptance criteria. If any of the 5 compounds listed above (EPA 5000 compounds) or more than 3 of the remaining compounds fail acceptance criteria, corrective action must be taken. Also, any failures must be sporadic (ie: random); if the same analyte fails repeatedly, the source of the error must be located and corrected.

Note: Because the sample preparation and analysis steps are the same for both standards and samples, the LCS may be reported as the CCV. For these runs, enter the LIMS

style as "CCV/LCS" in the sequence so LIMS can automatically generate both reports.

After the batch QC has finished running, determine if the LCS passed acceptance criteria for all of the client-specified limits associated with each job in the batch:

- 1.) Go to the GC/MS VOA Page within the LIMS Intranet
- 2.) Enter the batch number, job number with its product and matrix in the correct fields
- 3.) Click on "View" QC status for batch and check the results.

Note: Project specific quality assurance plans may require batch control based on different compounds and control limits, in which case the project requirements supersede this SOP for all samples related to that project.

Blank Spike (BS)/ Blank Spike Duplicate (BSD):

If there is insufficient sample volume to prepare a matrix spike and matrix spike duplicate (typical for water samples), the LCS should be prepared and analyzed in duplicate. Name these aliquots "BS" and "BSD" respectively (instead of "LCS"), so that LIMS will look for the duplicate and calculate the RPD's between the two, as well as the recoveries for each.

Sporadic marginal failures are allowed for 5% (3 compounds) of the target 8260 and GASOX compounds, except that the compounds listed in EPA 5000 Section 5.5.1 must pass acceptance criteria.

Corrective Action for LCS/BS/BSD Failures

If any of the 5 required compounds (EPA 5000 compounds) or more than 3 of the remaining compounds fail acceptance criteria, corrective action must be taken. These criteria should be applied discretely to each of the 3 sets of data, where the sets are the BS recoveries, the BSD recoveries, and the BS/BSD RPD. Use the following guidelines to determine the appropriate course of action:

- a.) If the samples are being analyzed for a subset or abbreviated target compound list and all of those compounds pass acceptance criteria, the data may be reported without further corrective action.
- b.) If high recoveries are observed but no target analytes were detected in the associated samples, note the failure on the Data Review Checklist and report the data without re-analysis, as the potential high bias does not affect the sample results.
- c.) If high recoveries are observed and the samples contain target compounds at levels above the reporting limits, the samples must be re-analyzed.
- d.) If high RPD's are observed but the recoveries are within acceptance limits and no target analytes were detected in the associated samples, note the failure on the Data Review Checklist and report the data without re-analysis, the lack of acceptable precision data does not affect ND samples.

- e.) If high RPD's are observed and the samples contain target compounds at levels above the reporting limits, the samples must be re-analyzed.
- f.) If low recoveries are observed for any surrogate and or spike the associated samples must be re-analyzed.

If a sample must be re-analyzed and the holding time has expired, the client's Project Manager should log the sample in as an "alias" and have the sample re-analyzed as the new sample number. If the sample is still within holding time, reanalyze the sample under the original sample number.

4.) Method Blank (MB):

A method blank (MB) must be analyzed for each batch of 20 or fewer samples and for 12-hour analytical shift, after the CCV and prior to any sample analysis. This serves as a check on system and atmospheric contamination in the laboratory at the time of sample analysis.

4.1) *Water Mode:* Fill a 40mL VOA vial with Ultrafiltered DI water.

Soil Mode: Add 5mL of Ultrafiltered DI water to a 40mL VOA vial.

4.2) Analyze the blank using the same data acquisition method as for the samples, typing "MB," before the QC-number.

4.3) Review the data from the first method blank before loading the rest of the sequence. In general, no compounds should be detected in the method blank. However, if a compound(s) is detected, the following steps are used to determine the corrective action required:

- a.) If the compound(s) is a common lab contaminant (e.g acetone or DCM) and the result is less than the reporting limit, document the contamination on the batch sequence summary, and report the data without reanalysis.
- b.) If the compound(s) is not a common lab contaminant and the concentration is less than 1/2 of the reporting limit, document the contamination on the batch sequence summary and report the data without reanalysis. If the compound is present at less than the RL and more than 1/2 the RL and the client is DoD, you may be required to reanalyze the sample.
- c.) If the sample result for that compound(s) is greater than twenty (20) times the amount found in the method blank, document the contamination on the batch sequence summary and the data review checklist and report the data without reanalysis.
- d.) If the sample result for that compound(s) is greater than the reporting limit but less than twenty (20) times the amount found in the associated method blank, the samples must be re-batched and reanalyzed.

Note: For any Department of Defense (Navy, USACE, AFCEE) project that references the DoD Quality Systems Manual (QSM), if the sample result for that

compound(s) is greater than ten (10) times the amount found in the method blank, document the contamination on the batch sequence summary and the data review checklist and report the data without reanalysis. If the sample result for that compound(s) is greater than the reporting limit but less than ten (10) times the amount found in the associated method blank, the samples must be re-extracted and reanalyzed.

Note: Project-specific quality assurance project plans (QAPPs) requirements may be more stringent. If so, those QA Plans supersede this SOP for all samples related to that project.

Instrument blanks (IB's) should be analyzed periodically throughout the analysis. IB's run after any standard or sample suspected to contain target compounds much greater than the linear working range (~1 ppm) are a good idea. Also, an IB should be run when the system has been idle for a few hours within a 12-hr shift before loading sample to ensure the system is 'clean.' The IB is used solely to 'clean' the system and is not reported.

Methanol prep blanks: This prep blank only needs to be analyzed once so long as there is a DI water blank analyzed in each 12-hour shift containing the MeOH extracts. These blanks consist of 10mL of methanol plus 10uL of TFT. A 200uL aliquot of this extract is added to each 5mL of DI water purged and is assigned a QC number, using the LIMS "stypc" PREPBLK. If any target compounds are detected in the methanol blank *and* in the associated method blank, reanalyze the methanol blank. If any target compounds are detected in the methanol blank that are not detected in the associated method blank, follow the procedure under "Method Blank" section 4.3 above to determine if the data is reportable. The results of MeOH Blanks may have to be reported for some clients.

TCLP Leachate prep blanks: Analyze in either soil or water mode as described above, run TCLP prepblanks as an additional Blank so we can report it to clients. Substitute the TCLP extraction fluid for the DI water, in each 12-hour shift containing the TCLP extracts. TCLP blanks should be run in the same sequence as TCLP samples. If any target compounds are detected in the TCLP blank, reanalyze the TCLP blank; if the presence of any target compounds is confirmed, follow section 4.3 above to determine if data are reportable.

5.) Matrix Spike (MS) and Matrix Spike Duplicate (MSD):

One sample in each analytical batch of twenty of similar matrix (or less) must be used for an MS/MSD. Matrix spikes are analyzed to demonstrate the accuracy (recovery) and precision (RPD) of the analysis in real-world samples. The matrix spiking solution contains all analytes of interest, but the MS and MSD are typically monitored only for those compounds listed in method 8260B Section 5.13, unless otherwise specified by the client.

5.1) Decide which client's sample to spike on a rotating basis, so that no one client's samples predominate over time.

5.2) *Soil samples in Soil Mode:* Weigh two additional aliquots, into VOA vials labeled "MS" and "MSD". Dispense 5mL of DI water into each vial then add 1 µL each of SU-ICV250, S-ICVGAS250, and ICVGASOX to each vial.

Water Mode: To make 25 µg/L matrix spike, spike a 100mL volumetric filled with the sample selected for QC with 10 µL each of SU-ICV-250, S-ICVGAS250, and

ICVGASOX. Invert three times and pour into two VOA vials, labeled with the QC numbers, leaving no headspace in the VOA.

TCLP Leachates: Leachate spikes may be run in either soil or water mode. Use the volumes above but substitute a TCLP leachate for the water sample.

Note: USACE recommends ICAL standards or a standard from the same manufacturer as the ICAL standards be used for spike standards. However EPA 8260B forbids this. Per 8260 Section 5.13.2, the spiking standards must be from a different source than the ICAL standards.

- 5.3) Analyze the MS and MSD using the same data acquisition method as for the samples, typing "MS," (or "MSD," as appropriate) before the QC-number.
- 5.4) Review the MS/MSD data. If either the recoveries or RPD fail criteria, determine whether or not the data can be reported based on the following:
 - a.) If the concentration of a target compound in the sample is greater than the linear range and the sample needs to be rerun for just that compound, report the MS/MSD with a LIMS-flag of ">LR" on those recoveries without reanalysis.
 - b.) If the concentration of a target compound in the sample is within linear range but the concentration in the matrix spikes is greater than the linear range, LIMS will apply a ">LR" flag to those recoveries. Report the data without reanalysis.
 - c.) If the concentration of a target compound is greater than 4x the spiking level, LIMS will apply a "NM" (for "Not Meaningful") flag to those recoveries. Report the data without reanalysis.
 - d.) If recoveries fail but the RPD is within acceptance limits, matrix interference is usually suspected. Narrate the failure and report the data without reanalysis (except for USACE, or other Level 3 or Level 4 projects that always require reanalysis).
 - e.) If the recoveries fail due to obvious chromatographic interference (ie: coelution of sample hydrocarbons or other analytes with the spike compounds), narrate the failure on the Data Review Checklist and report the data without reanalysis.
 - f.) If the recoveries or RPD fails, and an isolated problem cannot be identified and documented, reanalyze the sample and matrix spikes.

Project specific quality assurance plans may include different requirements, in which case the project requirements supersede this SOP for all samples related to that project.

6.) Sample Preparation:

After checking out samples from the coldroom, allow them to come to room temperature prior to sample preparation or analysis. All flasks and syringes used during sample preparation should be rinsed at least three times with DI water between samples. If used to prepare samples with an intense odor or color, the flasks or syringes may require rinsing with methanol prior to the DI water rinses.

All water samples should be screened by headspace-GC/FID prior to analysis (see the "VOC Screening" SOP for that procedure), unless site history is available for that specific sample. The screening chemist should have written the estimated dilution factor, and the name and concentration of the highest target compound, on the job sheet. If no screening data is available, or for samples from long-standing projects or samples that are suspected to be problematic, check to see if site history is available.

The calibration of the dispenser used to add Nanopure water to the soil samples must be verified at least monthly and must be accurate to within 3% (4.85-5.15mL)
If compositing water samples, the composite receiver flask should be immersed in an ice bath (8260C sec 11.5.7.1.1)

a.) EPA 5030 Liquid Samples - in *water* mode:

- 1a. For undiluted samples, load the sample VOA vial directly onto the autosampler, making sure the vial label is flat and fits smoothly in the autosampler rack. Then program the autosampler to run in water mode.
- 1b. For dilutions, inject a measured aliquot of the sample into a volumetric flask (at least a 50mL flask), bring to volume with reagent water, and invert three times. Pour into a labeled VOA vial, making sure there is no headspace.
2. Load all samples and QC onto the autosampler and analyze in water mode.
3. The autosampler will draw up 5mL of sample into the purge vessel and add internal standard/surrogate mix automatically. The volume of internal/ surrogate standard added is dependent on the type of autosampler; see [Appendix 6](#) for specifics.
4. When the sequence is completed, use narrow-range pH paper (0-2.5 SU) to check the pH. Document the pH on the sequence log.

Note: Never dip the pH strip directly into the sample as it could contaminate the sample. Instead, place one drop of sample on the pH strip.

Note: Always allow an extra VOA vial for re-analysis. If a client requested an MS/MSD but only submitted 3 VOA vials, initiate a Corrective Action so the Project Manager can educate the client and inform them that we have insufficient sample volume to perform their requested MS/MSD.

b.) EPA 5030 Liquid Samples - in *soil* mode:

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- 1a. For undiluted samples, measure 5 mL of sample into a 5mL syringe and dispense into a labeled 40mL VOA vial. Check the pH using narrow-range pH paper (0-2.5 SU) and document it in the sequence log.
- 1b. For dilutions, inject a measured aliquot of the sample into reagent water for a total volume of 5mL. Check the pH using narrow-range pH paper (0-2.5 SU) and document it in the sequence log.
- 1c. Run MeOH and TCLP extracts in Soil mode. It is not necessary to check the pH of these samples

Never dip the pH strip directly into the sample as it could contaminate the sample.

2. Load sample onto the autosampler set up for soil mode.
 3. The autosampler will add the internal/surrogate standard mix and 5mL of water at the time of analysis. The volume of internal/ surrogate standard added is dependent on the type of autosampler; see [Appendix 6](#) for specifics.
 4. The autosampler (in soil mode) heats the samples to 40°C during the purge cycle.
- c.) **EPA 5030/5035 Solid Samples** (low level) - in *soil* mode:
For those clients that still submit soil samples in brass or steel sleeves, C&T uses the guidance from previous versions of EPA 5030, as follows:

1. Verify that the balance has been calibrated for that day. If not, perform calibration check and document it.
2. Write the sample number and letter on the vial and in the sample prep log.
3. Weigh 5.5g ($\pm 0.5g$) of sample into soil vial and record the weight to one decimal place. Use less if it is suspected that a dilution is needed. If the dilution needed is $> 10x$, perform a methanol extraction as described below.

Clean the spatula or scoop with DI water and a Kimwipe between samples to prevent cross-contamination. If the sample has an oily matrix or odor, rinse the spatula or scoop with methanol, and then with DI water; alternately, use a disposable wooden spatula. An oily matrix or strong odor should be extracted in methanol and screened at a higher dilution.

When weighing out samples for analysis, the analyst may notice sample heterogeneity exhibited by soils mixed with plant debris, rocks, and other materials. If samples have significant heterogeneity, describe the heterogeneity in the sample prep log and take the most visually representative aliquot possible from the sample. If the sample consists of large pebbles or rocks, discuss the problem with the client's Project Manager, as the client may need to be informed.

Dilutions of < 50x are made by using smaller aliquots of soil. Weigh out 2.5g for a 2x dilution or 1.0g for a 5x dilution. If a 2-decimal scale is used, a 10x dilution could be prepared by weighing 0.50g ($\pm 0.05g$).

4. Add 5 mL of reagent water to the VOA vial and place on the carousel.
 5. The autosampler will automatically add 5mL of reagent water and internal/surrogate standard mix at the time of analysis. The volume of internal/surrogate standard added is dependent on the type of autosampler; see [Appendix 6](#) for specifics.
 6. Samples are heated at 40°C during the purge cycle.
- d.) **EPA 5030/5035 Methanol Extracts of Soil Samples** (medium/high level):
For those clients that still submit soil samples in brass or steel sleeves, C&T uses the guidance from previous versions of EPA 5030 to analyze med/high-level soil samples, as follows:
1. Verify that the balance has been calibrated for that day. If not, perform calibration and document it.
 2. Write the sample number and container letter on a scintillation vial and in the Methanol Extractions log.
 3. Weigh 10g ($\pm 1.0g$) of sample into a scintillation vial and record the weight to one decimal place.

Clean the spatula or scoop with DI water and a Kimwipe between samples to prevent cross-contamination. If the sample has an oily matrix or odor, rinse the spatula or scoop with methanol, and then with DI water
 4. Add 10uL TFT1250, which acts as a surrogate for the extraction process, measuring potential errors or biases introduced during the extraction step.
 5. Using a Class-A graduated pipette or syringe, add 10mL Purge & Trap-grade Methanol and shake for 2 minutes.
 6. Let extract settle for about one hour or centrifuge for about 1 minute, until the layers are clearly separated.
 7. Transfer MeOH layer into a 4mL vial labeled with the sample number and letter.
 8. Analyze within 14-days of sample collection.

Soil mode: Aliquot 100 μ L (or less if a higher dilution is required) into 5mL of reagent water in a labeled VOA vial and place on carousel. Samples are heated at 40°C during the purge cycle.

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Water mode: Inject an aliquot of the extract into a volumetric flask filled with reagent water and bring to volume with reagent water. Invert 3 times and pour into a labeled VOA vial with no headspace. Be sure the methanol does not exceed 100 µL per 5mL of sample to be purged.

CAUTION: Aliquots of methanol extracts *must not* exceed 100 µL per 5mL purged or the trap may be damaged and response of the gas compounds, such as vinyl chloride, may be depressed.

Note: The second source standards do not contain the TFT surrogate. When running methanol extracts, do not run CCV/LCS or CCV/BS. Run a first source CCV which contains the TFT surrogate.

9. Store excess methanol extract volume in the refrigerator at 4°C.

Because the autosampler automatically adds the normal 8260 surrogates to every sample just prior to the purge cycle, C&T uses α , α , α -Trifluorotoluene (TFT) as the surrogate for the methanol extraction step.

e.) **EPA 5030 Waste Dilutions for Solvent or Oil Samples:**

1. Verify that the balance has been calibrated for that day. If not, perform calibration and document it.
2. Write the sample number and container letter on a scintillation vial and in the Methanol Extractions log.
3. Weigh 1g (\pm 0.1g) of sample into a 10mL Class-A volumetric flask and record the weight to one decimal place.

Clean the spatula or scoop with DI water and a Kimwipe between samples to prevent cross-contamination. If the sample has an oily matrix or odor, rinse the spatula or scoop with methanol, and then with DI water.

4. Add 10uL TFT1250, which acts as a surrogate for the extraction process, measuring potential errors or biases introduced during the extraction step.
5. Bring to volume with Purge & Trap-grade Methanol and vortex for 2 minutes.

If the sample is not miscible with the methanol, perform a methanol extraction as described in the previous section, using 1g of sample.

6. Analyze within 14-days of sample collection.

Soil mode: Aliquot 100 µL (or less if a higher dilution is required) into 5mL of reagent water in a labeled vial and place on carousel. Samples are heated at 40°C during the purge cycle.

Water mode: Inject an aliquot of the extract into a volumetric flask filled with reagent water and bring to volume with reagent water. Invert 3 times and pour

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into labeled VOA vial with no headspace. Be sure the methanol does not exceed 200 µL per 5mL of sample to be purged.

CAUTION: Aliquots of methanol extracts *must not* exceed 100 µL per 5mL purged or the trap may be damaged and response of the gas compounds, such as vinyl chloride, may be depressed.

7. Store excess methanol extract volume in the refrigerator at 4°C.

Because the autosampler automatically adds the normal 8260 surrogates to every sample just prior to the purge cycle, C&T uses α , α , α -Trifluorotoluene (TFT) as the surrogate for the methanol extraction step.

Note: The second source standards do not contain the TFT surrogate. When running methanol extracts, do not run CCV/LCS or CCV/BS. Run a first source CCV which contains the TFT surrogate.

ENCORES - EPA 5035 Sample Preservation & Preparation:

If EPA 5035 is requested as the preparation method for soil samples, three Encore devices should be submitted for each sample. The samples must be:

- a.) Analyzed within 48-hours of collection date/time as a normal soil sample, or
- b.) Chemically preserved within 48-hours with sodium bisulfate and analyzed within 14-days of collection date, or
- c.) Chemically preserved with methanol within 48-hours of the collection date/time and analyzed within 14-days from collection, or
- d.) Frozen* (with the client's prior permission within 48 hrs of sampling) and chemically preserved within 14 days from collection, or
- e.) Frozen* (with the client's prior permission within 48 hrs of sampling) and analyzed within 14 days from collection, *or*
- f.) Sampled in a pre-weighed documented 40mL VOA vial containing 5mL water, frozen with 48-hours (with the client's prior permission), and analyzed within 14 days from collection*.

* *Method Modification:* Region 9 has approved the use of freezing to extend the holding time for unpreserved samples to 14 days, however the client must approve this variance on a case-by-case basis. A copy of the USEPA Region IX Interim Policy Memorandum (June 23, 1999) is on file in the QA files.

Preservation: If the client has given permission for the Encores to be frozen, the samples will be placed in the Encore freezer by the login personnel and should be checked out like a normal soil sample and analyzed following step a.) "EPA 5035 Low-level unpreserved samples" below.

If the samples cannot be frozen, or analyzed within 48 hours of collection, preserve 2 Encores with sodium bisulfate and 1 Encore with methanol, as follows:

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Sodium Bisulfate Preservation:

1. Verify that the balance has been calibrated that day. If it has not, calibrate it before using for sample prep.
2. Write the sample number and container letter on a pre-preserved VOA vial and in the sample prep log.
3. Tare the pre-preserved VOA vial with a spin bar.
4. Using an EnCore extrusion tool, dispense the entire contents of the EnCore device into the tared VOA vial.
5. Record sample weight (to 2 decimals) in lab notebook.
6. For the second Encore, repeat Steps 1 through 7.
7. Store in the refrigerator at 4°C.
8. Analyze within 14 days of sample collection.

Methanol Preservation:

1. For the third Encore, write the sample number and container letter on a scintillation vial.
2. Using an EnCore extrusion tool, dispense the entire contents of the EnCore device into the tared scintillation vial.
3. Record the sample weight, to two decimal places, in a lab notebook.
4. Add 1uL TFT1250 for each 1mL of methanol added, which acts as a surrogate for the extraction process, measuring potential errors or biases introduced during the extraction step.
5. Use a Class-A graduated pipette or syringe to add an equal volume (to weight of sample) of Purge & Trap-Grade Methanol to the scintillation vial. Record the manufacturer and lot number of the methanol in the soil prep benchbook.
6. Shake or vortex the sample for 2 minutes.
7. Place in centrifuge, or let settle for approximately one hour, until methanol and soil are thoroughly separated.
8. Transfer the remaining methanol extract to a 4mL screw-cap vial and store the extract in the refrigerator at 4°C.
9. Analyze, if necessary, within 14 days of sample collection.

Method Modification: Methanol dilutions for Encores are done at 1:1 (volume: weight) instead of the method 1:2 so that there is not a reporting limit gap between the soil mode and the methanol dilution. Because the autosampler automatically adds the

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normal 8260 surrogates to every sample just prior to the purge cycle, C&T uses α, α, α -Trifluorotoluene (TFT) as the surrogate for the methanol extraction step.

Note: If the client prepared the methanol extracts, then the samples may not be extracted at 1:1. Calculate the prep dilution factor based on the weight and volume noted on the vial and enter this pdf when typing the sequence in Chemstation.

a.) **EPA 5035 Low-level unpreserved samples:**

1. Verify the balance has been calibrated for that day. If not, perform calibration and document it.
2. Write the sample number and container letter on a VOA vial and in the sample prep log.
3. Using an EnCore extrusion tool, dispense the entire contents of the EnCore device into the tared, labeled VOA vial.
4. Record sample weight (to two decimals) in soil prep benchbook.
5. Add 5mL reagent water and a disposable stir bar to the VOA vial, and cap the vial.
6. Analyze in *soil mode* within 48 hours of sample collection.

Note: Allow frozen samples to come to room temperature before analysis.

b.) **EPA 5035 Low-level Sodium bisulfate preserved samples:**

Analyze the preserved samples on the autosampler in soil mode, heating the sample at 40°C during the purge cycle.

c.) **EPA 5035 Methanol preserved (high-level) samples:**

1. Write the sample number and container letter on a VOA vial and in the run log.
2. *Soil mode:* Aliquot 100 μ L (or less if a higher dilution is required) into 5mL of reagent water into a soil vial and place on carousel. Samples will be heated to 40°C during the purge cycle.

Water mode: Inject an aliquot of the extract into a volumetric flask filled with reagent water and bring to volume with reagent water. Invert 3 times and pour into a labeled VOA vial, leaving no headspace. Be sure the methanol does not exceed 100 μ L/ 5mLs of sample to be purged.

CAUTION: Aliquots of methanol extracts *must not* exceed 100 μ L per 5mL purged or the trap may be damaged and response of the gas compounds, such as vinyl chloride, may be depressed.

Note: Because the autosampler automatically adds the normal 8260 surrogates to every sample just prior to the purge cycle, C&T uses α, α, α -Trifluorotoluene (TFT)

as the surrogate for the methanol extraction step. If the samples are client prepared methanol extracts, they will not contain the TFT surrogate.

QUANTITATIVE ANALYSIS

1.) Sample Quantitation:

Quantitation is based on comparison of the area of the primary ion in the sample's mass spectra to the initial calibration response factor for that compound. An Internal Standard (ISTD) technique is used to correct for purging efficiency and some types of matrix interferences. See Appendix_1 for example calculations.

A user report will be automatically generated once the run is complete. Review any method blank or LCS data results that have not already been reviewed, then review the sequence sample results to identify any samples that need to be rerun and/ or diluted. Review the sample results in the order in which the samples were run to identify any potential carryover or other instrument problems that may affect the sample results.

2.) Carryover:

Carryover may happen whenever a sample contains high- or over-range compounds. When this happens, the high-level compounds are not completely cleaned out of the system between samples and low levels of the same compound may be detected in subsequent samples but not actually be present in those samples; this is particularly true of late-eluting compounds such as naphthalene. If a sample contains the same low-level compound(s) that was present in the preceding sample at a concentration greater than the calibration range, reanalyze the sample to verify that the presence of the low-level hits is not due to instrument carryover.

In general, any compound may carryover after a 200ppb hit. Late eluters, particularly 1,2,4-Trichlorobenzene, Hexachlorobutadiene, Naphthalene, and 1,2,3-Trichlorobenzene, may carryover at 1-2%. Therefore, any hit for one of these compounds following a 50ppb hit in the previous run may be suspect. Samples with suspected carryover must be reanalyzed.

Caution: Be aware that a single run may not be sufficient to clean out the instrument after a very high-level sample; several runs may be required and if subsequent samples (beyond the immediately following sample) contain the same target compound at decreasing levels, these samples should also be reanalyzed. Experience with an instrument will dictate to the analyst what levels are not conducive to carryover.

3.) Dilutions:

Dilutions should be made so that the highest target compound falls near the mid point of the ICAL calibration curve. See [Appendix 4](#) for preparing soil sample (methanol) dilutions and [Appendix 5](#) for preparing water sample dilutions.

If a single target compound(s) is within 10x the calibration range of the instrument, prepare a dilution that will bring the over-range compound near the mid point of the calibration range. Report the majority of the target compounds from the first analysis and the over-range compounds from the in-range dilution.

If a target compound(s) are greater than 10x the calibration range, prepare a dilution that will bring the highest concentration compound into the upper half of the calibration range. Report all results from the in-range dilution.

If the sample chromatogram exhibits a typical fuel “hump”, analyze the sample at a dilution that will bring the “hump” baseline to approximately one to two times the height of the internal standard peaks. Do not try to analyze it at much higher levels, as the background hydrocarbons may obscure target compounds. On the Data Review Checklist, narrate raised reporting limits, and possible failing BFB surrogate recovery, as due to hydrocarbon background interferences.

If the sample chromatogram includes a large but narrow non-target peak, analyze the sample at a dilution that will bring the non-target peak to no more than 5 times the height of the internal standard peaks. On the Data Review Checklist, narrate raised reporting limits as due to non-target matrix interferences.

If the sample chromatogram includes a very wide non-target peak, be aware that this peak may obscure target compounds or shift retention times of later-eluting compounds and dilute accordingly; discuss the problem with the Department Manager or QA Director. On the Data Review Checklist, narrate raised reporting limits as due to non-target matrix interferences.

If a sample is analyzed at multiple dilutions, compare the sample results across the various dilutions to verify that the dilutions were prepared correctly. Do the results make sense or is there a discrepancy between the runs? If there seems to be a discrepancy, reanalyze the sample to confirm the results.

If the sample was analyzed as a methanol extract and the TFT surrogate recovery is outside acceptance limits, while the normal 8260 surrogates are within limits, the problem most likely occurred during the MeOH extraction or dilution steps. The sample should be re-extracted and reanalyzed.

4.) Surrogates:

Surrogate compounds are chemically similar to the target analytes but are compounds not found in actual samples. These compounds are added to every sample, spike, and standard to monitor the efficiency of the analysis of that sample. In-house Surrogate Acceptance Criteria are specified in the associated SOP ‘8260B Laboratory Control Limits, Table-1’. These limits are generated semi-annually, using control charts. The autosampler will automatically add surrogate standard to every sample, standard, blank and spike for a final concentration of 50ppb. The volume of surrogate standard added is dependent on the autosampler; see [Appendix 6](#) for specifics.

Surrogate compounds: Dibromofluoromethane
1,2-Dichloroethane-d4
Toluene-d8
4-Bromofluorobenzene
 α , α , α ,-Trifluorotoluene (MeOH Extractions only)

If a surrogate recovery is outside QC limits, determine whether reanalysis is required using the following criteria:

- a.) If a high recovery is observed but no target analytes were detected above the reporting limit in the sample, note the failure on the Data Review Checklist and report the data without reanalysis.
- b.) If a high recovery is observed but the chromatogram and spectra display obvious coelution of sample hydrocarbons with the surrogate, note this on the user report and the Data Review Checklist and report the data without reanalysis (as hydrocarbons typically coelute with BFB).
- c.) If a high recovery is observed and neither case a. or b. above apply, verify that the LIMS S# (and therefore the amount and concentration) of surrogate added to the sample is correct. If these are correct, the sample must be reanalyzed. Check for correct operation of the GC or Purge-and-Trap before starting the new sequence.
- d.) If a low recovery was observed and analysis was needed to quantitate only a limited number of analytes that were >LR in a previous run, those analytes may be reported so long as they are not associated with the failing surrogate.
- e.) If a low recovery is observed on a “miscellaneous” matrix, the sample should be reanalyzed after being extracted into MeOH extraction or otherwise diluted to remove the matrix interference.
- f.) If the sample was analyzed as a methanol extract and the TFT surrogate recovery is outside acceptance limits, while the normal 8260 surrogates are within limits, the problem likely occurred during the MeOH extraction or dilution steps. If a high TFT recovery is observed, report the data without further corrective action. If a low TFT recovery is observed, the sample should be re-extracted and reanalyzed.
- g.) If low recoveries are observed and none of the above (d., e., f.) apply, the sample must be reanalyzed.

If reanalysis is performed within the holding time and the surrogate recovery for the reanalysis is within acceptance limits, report only the reanalysis.

If reanalysis is performed within the holding time and the surrogate recovery is again outside limits, report the run with the better surrogate recovery. Note the matrix effect as “confirmed matrix interference” on the User Report and the Data Review Checklist.

If a sample must be reanalyzed and the holding time has expired, have the client’s Project Manager log the sample in as an alias and reanalyze the sample as the new sample number and report results for both runs.

Note: Project specific quality assurance plans may require batch control based on different compounds and control limits, in which case the project requirements supersede this SOP for all samples related to that project.

5.) Internal Standards:

Internal standard compounds are chemically similar to the target analytes but are compounds not found in actual samples. These compounds are added to every sample,

spike, and standard and are used to adjust quantitation for slight differences in purging efficiency and some types of matrix interferences (see Appendix_1 for example calculations and [Appendix 11](#) for target analyte/ ISTD assignment. The autosampler will automatically add internal standard to every sample, standard, blank and spike for a final concentration of 50ppb. The volume of internal standard added is dependent on the autosampler; see Appendix_6 for specifics.

Internal standards:	Pentafluorobenzene	1,4-Dichlorobenzene-d4
	1,4-Difluorobenzene	Chlorobenzene-d5

Method Modification: EPA 8260B recommends the use of Fluorobenzene as an internal standard, however C&T uses Pentafluorobenzene instead, as it elutes earlier than Fluorobenzene and better represents the early eluting compounds.

Review the internal standards results against the following criteria:

- a.) The retention time of the internal standards must be within ± 0.5 minutes of the internal standard retention times in the mid-point standard of the initial calibration.
- b.) The area of each internal standard must fall between 50-200% of the mid-point standard in the initial calibration.

If internal standard recoveries are out of compliance, use the following to determine the appropriate corrective action:

- c.) If, upon visual inspection of chromatograms, matrix interference is apparent (ie: background is 2 to 5 times higher than the nearest internal standard) and no target analytes were detected, the data may be reported without corrective action. Narrate the interference.
- d.) If obvious matrix interference is not present, the sample must be reanalyzed.
- e.) If, upon reanalysis, the same internal standard falls outside QC limits, report the better of the two runs and narrate the failure as due to confirmed matrix interference.

For CCV's, method blanks, and laboratory control samples, an internal standard area or retention time failure indicates a problem with the QC sample or standard preparation efficiency, or instrument performance and all samples associated with that QC sample must be reanalyzed.

QUALITATIVE ANALYSIS

Identification of compounds is based on retention time and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference spectrum.

The reference spectrum for target compounds is generated from the initial calibration standards. The characteristic ions from the reference mass spectrum are defined as the three ions of greatest relative intensity, or any ions over 30% relative intensity if less than three such ions occur in the reference spectrum.

The following criteria need to be met for positive identification of a compound:

- 1) The retention time of the sample component is within 0.05 minutes of the standard component.

Method Modification Note: Method 8260B (Section 7.6.1.2) calls for a relative retention time of ± 0.06 from the standard, however this results in windows that are too wide for use with highly contaminated samples. C&T uses the tighter criteria of within 0.05min.

- 2) The retention time of the associated internal standard must be within ± 0.5 minutes of the internal standard retention times in the mid-point standard of the initial calibration.
- 3) The retention times of the characteristic ions should match.
- 4) The relative intensities of the characteristic ions (for target analytes and tentatively identified compounds, "TICs") agree within 30% of the same ions in the reference spectrum.

Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance must be between 20 - 80%.

- 5) Structural isomers may be reported as individual isomers so long as the height of the valley between the two peaks should be less than 25% of the sum of the two peak heights, otherwise they should be identified as isomeric pairs (8260B, Section 7.6.1.4).

Samples may contain background interferences that obscure the target compounds, particularly when the sample contains high levels of hydrocarbons. If the sample was analyzed at a correct dilution, as defined in the "[Dilutions](#)" section above, but the spectral pattern of the target compound is not *readily identifiable* and distinct from the background noise, that compound should be reported as "Not Detected". Analyst judgment should weigh heavily in the judgment as to *readily identifiable*; ask for a second opinion from a Senior Analyst, Department Group Leader or QC Chemist if you are unsure.

Check the integration of the quantitation ion as you examine the spectra. Peaks are integrated from baseline to baseline unless the matrix causes interferences with the ion ratios, in which case only the part of the peak with the correct ions should be integrated. For problematic analytes, manual integrations must be consistently applied to ICAL, CCS, and sample integrations. **Unsubstantiated alteration of peak integration solely to pass calibration or QC criteria is illegal and is grounds for immediate termination.** The Target software will flag any manual integration with an "M" on the quant report next to the concentration for that compound.

Verify that both the original and the reprocessed data are in the LIMS for the integrated sample. Document the reason for manual integration (via the comment field) on sample report in LIMS. DoD clients have specified that they want all manual integrations narrated in the comment field, no matter how obvious the reason appears.

If a compound does not meet the criteria outlined above, check the false positive box on the sample report in LIMS. After all retention times, spectra, internal standards, and surrogate

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recoveries have been reviewed, the primary analyst should choose the reported analytes and electronically sign the sample report in LIMS.

DATA REVIEW & REPORT ASSEMBLY

All data must be reviewed by a second party (peer, QC Chemist, or Department Manager) prior to reporting. See [Appendix 13](#) for instructions on working up data in Target and or Chemstation and LIMS.

WASTE DISPOSAL

After analysis, the VOA vials containing remaining sample volume should be returned to the VOA refrigerator, with the vial placed upside down in the VOA box to indicate that it was already used. Spent water samples should be transferred to the 'Corrosive' waste stream and solid samples to the 'Solid' waste stream. After the sample holding times have expired, leachates should be transferred to the 'Aqueous' waste stream, and methanol extracts to the 'Flammable Solvents' waste stream. Expired standards should be transferred to the 'Flammable Solvents' waste stream.

POLLUTION PREVENTION

Direct the split vent and septum purge lines through a carbon trap in order to reduce solvent emissions into the laboratory. Prepare only sufficient standard and reagent volume that can be used within the expiration date, to reduce the volume of waste generated by the laboratory and to reduce production cost.

REVISION HISTORY

This is Revision 10. Revision 9 has been changed as follows:

- References updated
- Standards Preparation recipes were updated
- MDL requirements were revised to harmonize DoD QSM and NELAC guidance.

APPENDIX_1: CALCULATIONS

SAMPLE QUANTITATION

Soil samples are reported on a wet-weight basis unless dry-weight is requested by the client.

$$\begin{aligned}\% \text{ Dry Weight} &= \text{g of dry sample} * 100 / \text{g of sample} \\ 100 - \% \text{ Dry Weight} &= \% \text{ Moisture}\end{aligned}$$

Significant figures: Concentrations less than 1.0 are reported to 1 significant figure, those greater than 1.0 are reported with 2 significant figures.

Concentration via Average Response with Internal Standard (Aqueous Samples)

$$\text{Concentration (ug/L)} = (A_x * C_{is} * D) / (A_{is} * R_{rf} * V_s)$$

Where:

- A_x = Area response for the analyte in the sample
- C_{is} = Amount (mass) of Internal standard added in ng
- D = Dilution Factor, if no dilution $D = 1$, dimensionless
- A_{is} = Area response for the internal standard
- R_{rf} = Relative Response Factor for the analyte as determined below
- V_s = Volume of Water extracted or purged, in mL

Concentration via Average Response with Internal Standard (Non Aqueous Samples)

$$\text{Concentration (ug/Kg)} = (A_x * C_{is} * D) / (A_{is} * R_{rf} * W_s)$$

Where:

- A_x = Area response for the analyte in the sample
- C_{is} = Amount (mass) of Internal standard added in ng
- D = Dilution Factor if no Dilution $D = 1$, dimensionless
- A_{is} = Area response for the internal standard
- R_{rf} = Relative Response Factor for the analyte as determined below
- W_s = Mass of sample purged in grams

Concentration via Linear Regression with Internal Standard

$$\text{Concentration (ug/L or ug/Kg)} = (a_0 + a_1 * (A_x * C_{is} / A_{is})) * PDF * IDF$$

Where:

- a_0 = Y-intercept of regression equation
- a_1 = slope of regression equation
- A_x = Area response for the analyte in the sample
- C_{is} = Amount (mass) of Internal standard added in ng
- A_{is} = Area response for the internal standard
- IDF = Instrument Dilution Factor
- PDF = Prep Dilution Factor (V_f/V_i or V_f/W_i), for P&T $D = 1$, dimensionless

Concentration via Quadratic Equation with Internal Standard

$$\text{Concentration (ug/L or ug/Kg)} = (a_0 + a_1 * (A_x * C_{is}/A_{is}) + a_2 * (A_x * C_{is}/A_{is})^2) * PDF * IDF$$

Where:

- a_0 = Y-intercept of regression equation
- a_1 = Slope of regression equation
- A_x = Area response for the analyte in the sample

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Cis = Amount (mass) of Internal standard added in ng
Ais = Area response for the internal standard
a2 = Quadratic coefficient
IDF = Instrument Dilution Factor
PDF = Prep Dilution Factor (V_f/V_i or V_f/W_i), for P&T D =1, dimensionless

BATCH QC

Percent Recovery (%R):

The recovery is the measured concentration divided by the true concentration of the spike.

$$\% \text{Recovery} = (C_f - C_s) / (C_{ws} * V_{ws} / S) * 100$$

Where: Cf = final measured concentration in the spiked sample
Cs = measured concentration in the un-spiked aliquot of sample
Cws = concentration of the spiking standard
Vws = volume used, of the spiking standard
S = Sample weight or volume

Relative Percent Difference (RPD):

The RPD is the absolute value of the difference in concentrations divided by the average of the concentrations.

$$\% \text{RPD} = |(C_s - C_{dup})| / ((C_s + C_{dup})/2) * 100$$

Where: Cs = measured sample concentration
Cdup = measured concentration in the duplicate

For soil MS/MSD's where the sample weights are not weight-targetted, the expected concentrations will vary with sample weight (because the same volume of spike standard is being added to different weights of sample) and must be accounted for when calculating RPD:

$$\% \text{RPD} = |((W_{ms}/W_{msd}) * C_{ms} - C_{msd})| / (((W_{ms}/W_{msd}) * C_{ms} + C_{msd})/2) * 100$$

CALIBRATION VERIFICATION

$$\% \text{ Difference (\%D)} = (\text{AvgRrf} - \text{Rrfc}) / \text{AvgRF} * 100$$

Where: AvgRrf = Average response factor from initial calibration
Rrfc = Response factor from current verification check standard

$$\% \text{Drift (\%D)} = (\text{C1} - \text{Cc}) / \text{C1} * 100$$

Where: C1 = Calibration Check Compound standard concentration
Cc = Measured concentration of CCC

INITIAL CALIBRATION

$$\text{Relative Response Factor (RRF)} = \frac{\text{Ax} * \text{Cis}}{\text{Ais} * \text{Cx}}$$

Where: Ax = Area of the characteristic ion for the compound being measured
Ais = Area of the characteristic ion for the specific internal standard
Cis = Concentration of the specific internal standard
Cx = Concentration of the compound being measured

$$\% \text{ Relative Standard Deviation (\%RSD)} = \text{SD}/\text{X}$$

Where: X = Mean of initial RRFs for a compound
SD = Standard deviation of RRFs for a compound
$$= \text{SQRT} \left(\sum_{i=1}^n ((\text{Rrf}_i - \text{avg Rrf})^2 / (n-1)) \right)$$

Linear Correlation Coefficient (or “Coefficient of Determination” for non-linear curves):

$$\text{Correlation coefficient} = \frac{\sum_{i=1}^n (\text{Yobs} - \text{Ymean})^2 - ((n-1)/(n-p)) * \sum_{i=1}^n (\text{Yobs} - \text{Yi})^2}{\sum_{i=1}^n (\text{Yobs} - \text{Ymean})^2}$$

Where: Yobs = observed response (area or absorbance) for each ICAL std conc.
Ymean = mean observed response from the ICAL standards
Yi = calculated (or predicted) response for each ICAL std conc.
n = total number of ICAL points
p = number of adjustable parameters in equation (linear= 1, quadratic= 2)

APPENDIX_2: STANDARDS & REAGENTS

The gases are received in ampules that are cracked open on a daily basis. The non-gas standards are stored in multiple vials, each of which is used for approximately one week; the other ampules are stored at <-10°C until placed in use. The holding time for each ampule will be noted as one day for the gaseous standards and one week for the non-gaseous standards from the date the ampule is placed in use.

The standards and reagents listed below are those in use at the time this procedure was written. Alternate supplies may be used so long as they are of equivalent quality and all other calibration, quality control, and traceability requirements are met.

DAILY STANDARDS

Soil Mode:

BFB	1 µL	PTASS50	direct injection onto GC or
	1 µL	PTASS50	injected in 5mL DI water

CCV prepared the same as Initial Calibration standard for appropriate level.

Note: If running a CCV/LCS, you must use second source standards and remember to vary the concentration daily (NELAC requirement)

LCS/BS/BSD	1 µL	SU-ICV250	injected in 5 mL DI water
	1 µL	S-ICVGAS250	
	1 µL	S-ICVGASOX	
	1uL	VOANTICV	

MS/MSD	1 µL	SU-ICV250	injected in 5 mL sample
	1 µL	S-ICVGAS250	
	1 µL	S-ICVGASOX	
	1uL	VOANTICV	

Water Mode:

BFB	1 µL	PTASS50	direct injection onto GC or
	20µL	PTASS50	injected into 100mL DI water and
			transferred to a 40mL VOA vial w/o
			headspace in water mode
mode	1 µL	PTASS50	injected in 5mL DI water and run in soil

CCV prepared the same as Initial Calibration standard for appropriate level.

Note: If running a CCV/LCS, you *must* use second source standards and remember to vary the concentration daily (NELAC requirement)

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LCS/BS/BSD 10 µL SU-ICV250 injected into 100mL DI water and
 transferred 10 µL S-ICVGAS250 to 40mL VOA vials w/o
 headspace
 10 µL ICVGASOX
 10uL VOANTICV

MS/MSD 10 µL SU-ICV250 injected into 100mL DI water and
 transferred 10 µL S-ICVGAS250 to 40mL VOA vials w/o headspace
 10 µL ICVGASOX
 10uL VOANTICV

Note: USACE recommends ICAL standards or a standard from the same manufacturer as the ICAL standards be used for spike standards. However EPA 8260B forbids this. Per 8260 Section 5.13.2, the spiking standards must be from a different source than the ICAL standards.

8260 + GASOX _ INITIAL CALIBRATION STANDARDS

For standards with a final volume of 5mL (Soil Mode), prepare in a clean-rinsed gas-tight class-A volumetric syringe. For the standards with a final volume of >5mL (Water Mode), prepare in a volumetric flask. For both water-mode and soil-mode, the volume of standard (or sample) purged is 5mL

SOIL MODE					
ICAL Standard Conc. (µg/Kg)	Add Vol (µL) 8260GOXTFT500	Add Vol (µL) CR-GAS500	Add Vol (µL) VOANT500	Final Volume (mL)	CAL LEVEL
2.5	0.5	0.5	0.5	100	1
5	1	1	1	100	2
10	2	2	2	100	3
20	4	4	4	100	4
50	10	10	10	100	5
60	12	12	12	100	6
75	15	15	15	100	7
100	20	20	20	100	8
200	40	40	40	100	9

WATER MODE						
ICAL Standard Conc. (µg/L)	Add Vol (µL) 8260GOXTFT500	Add Vol (µL) CR-GAS500	Add Vol (µL) 2-CLEVE1000	Add Vol (µL) VOANT500	Final Volume (mL)	CAL LEVEL
0.25 (0.5 gas)	0.5	1	0.5	0.5	1000	1
0.5 (1.0 gas)	1	2	1	1	1000	2
2	2	2	1	1	500	3
5	5	5	2.5	2.5	500	4

10	2	2	1	1	100	5
20	4	4	2	2	100	6
50	10	10	5	5	100	7
75	15	15	7.5	7.5	100	8
100	20	20	10	10	100	9

Alternatively, an initial calibration can be made using the normal ICAL standards and 10x diluted working standards from the same manufactured source as the normal ICAL standards. Following the table below using the same preparation guidance mentioned above.

SOIL MODE (ALTERNATIVE)					
ICAL Standard Conc. (µg/Kg)	Add Vol (µL) 8260@10XB	Add Vol (µL) CR-GAS500@10X	Add Vol (µL) VOANT50	Final Volume (mL)	CAL LEVEL
2.5	5	5	5	100	1
5	10	10	10	100	2
10	20	20	20	100	3
ICAL Standard Conc. (µg/Kg)	Add Vol (µL) 8260GOXTFT	Add Vol (µL) CR-GAS500	Add Vol (µL) VOANT500	Final Volume (mL)	CAL LEVEL
20	4	4	4	100	4
50	10	10	10	100	5
60	12	12	12	100	6
75	15	15	15	100	7
100	20	20	20	100	8

WATER MODE (ALTERNATIVE)						
ICAL Standard Conc. (µg/L)	Add Vol (µL) 8260@10XB	Add Vol (µL) CR-GAS500@10X	Add Vol (µL) 2-CLEVE@10X	Add Vol (µL) VOANT50	Final Volume (mL)	CAL LEVEL
0.25(0.5 ppb gases)	2.5	5	2.5	2.5	500	1
0.5 (1ppb gases)	5	10	5	5	500	2
2	4	4	2	2	100	3
5	10	10	5	5	100	4
10	20	20	10	10	100	5
ICAL Standard Conc. (µg/L)	Add Vol (µL) 8260GOXTFT	Add Vol (µL) CR-GAS500	Add Vol (µL) 2-CLEVE	Add Vol (µL) VOANT500	Final Volume (mL)	CAL LEVEL
20	4	4	2	2	100	6
50	10	10	5	5	100	7

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75	15	15	7.5	7.5	100	8
100	20	20	10	10	100	9

8260 _ ICV- SUPELCO

<i>Soil Mode:</i>	SU-ICV250B	1µL injected into 5mL DI water
	S-ICVGAS250	1µL injected into 5mL DI water
	ICVGASOX	1µL injected into 5mL DI water
<i>Water Mode:</i>	SU-ICV250B	10µL injected into 100mL DI water
	S-ICVGAS250	10µL injected into 100mL DI water
	ICVGASOX	10µL injected into 100mL DI water

WORKING STANDARD PREPARATION

“Working standards” are those standards that are prepared by C&T. Document the preparation of all working standards in the standards prep benchbook and in the LIMS through the “Standards Inventory” table; LIMS will then assign a standard number (S#). For working standards, the LIMS S-name is not necessarily unique to the source standard vendor used in making the working standard but *is* unique to the compound list and concentrations contained in the working standard. If the concentration or compounds in the working standard changes, a new S-name, compound list and concentrations must be entered in the “Standards Definitions” table before the standard can be logged in and assigned an S#. It is *very important* to enter this information correctly, as LIMS uses this information to calculate spike and surrogate recoveries. Discuss with a Group Leader or Department Manager before defining a new standard in “Standards Definitions” table.

The benchbook entry should include the prep date, source standard information (LIMS S#, concentration, and volume of standards used), solvent name, solvent volume, solvent lot#, final volume and concentration of Working Standard, expiration date of Working Standard, and prep chemist’s initials. Once the benchbook entry is completed, scan the benchbook page into LIMS.

Prepare working standards in purge-and-trap grade methanol using gas-tight Class-A syringes. Working standards expire either 60 days from the date prepared (30 days for the gases), or on the earliest expiration date of the source standards used to make the working standard, whichever comes first. **The expiration date of a working standard cannot exceed the expiration date of the source standard(s) used to prepare it.** If the expiration date assigned by LIMS to the working standard exceeds that of any of the source standards used to prepare it, advance the expiration date to the earliest expiration date of the source standards; update the LIMS entry and document the correct expiration date in the benchbook. Label the vials with the contents, LIMS S#, and expiration date. Store the standards in a freezer at < -10°C.

EPA 624 Method Modification: Method 624 instructs the analysts to prepare the gases and 2-Chloro-ethylvinylether weekly and the others monthly, however C&T uses gas-tight ampules for standards storage & has demonstrated through the analysis of PT samples that this practice allows additional shelf-life without affecting the quantitation of real-world samples.

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Working Standard & Conc. (µg/L)	Final Vol (mL) in MeOH	Using Source Std	Add Vol (mL) Source Std	LIMS S-Name
BFB 50ppm	20.0	S-550	1.0	PTASS250
		MeOH	19.0	
IS+Surrogate 500ppm	100	CT-IS-SURR-10	10	VOAISS500R
		MeOH	90.0	
IS+Surrogate 250ppm	20	VOAISS500R	10	VOAISS250R
		MeOH	10	
IS+Surrogate 125ppm	40	VOAISS500R	10	VOAISS250R
		MeOH	30	
VOA Gas Mix 500ppm	As received	CR-GAS500	As Received	CR-GAS500
VOA Gas Mix 50ppm	1.5	CR-GAS500	0.15	CR-GAS@10x
		MeOH	1.35	
VOA + Gasox Mix (w/o gases) 500ppm	4.0	TETRAMTHF	0.0025	8260GOXTFT
		VOACAL-1	0.40	
		XQ-1507	1.0	
		R-VINYLAC	1.0	
		R-CAL2000	1.0	
		MeOH	0.5975	
VOA + Gasox Mix (w/o gases) 50ppm	1.5	8260GOXTFT	.15	8260@10XB
		MeOH	1.35	
VOA extra compounds	4	1CLHexane	1	VOANT500
		RHEX5000	0.4	
		S-IODO2K	1	
		MeOH	1.6	
VOA extra compounds @10X	1.5	VOANT500	0.15	VOANT50
		MeOH	1.35	
2-Chloroethylvinylether	As received	2-CLEVE	As Received	2-CLEVE

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Working Standard & Conc. (µg/L)	Final Vol (mL) in MeOH	Using Source Std	Add Vol (mL) Source Std	LIMS S-Name
ICV (2 nd Source) w/o gases 250ppm	8.0	4MTHFICV	0.0025	SU-ICV250B
		AM-502-AR	1.0	
		AM-8260-ADD	1.0	
		MeOH	4.9975	
ICV (2 nd source) extra compounds	4.0	S2190	1.0	VOANTICV
		S869	1.0	
		MeOH	2.0	
ICV (2 nd Source) Gas Mix 250ppm	8.0	ACCU-VOC	1.0	S-ICVGA250
		MeOH	7.0	
Trifluorotoluene Surrogate (for MeOH extracts only)	1.6	TFT2000	1.0	TFT1250
		MeOH	0.6	

SOURCE STANDARDS

“Source Standards” are those standards that are purchased from an outside vendor. All source standards must be logged into LIMS upon receipt, through the “Standards Inventory” table. For source standards, the LIMS S-name is unique to the manufacturer of the standard; if a source standard is obtained from a different manufacturer, a new S-name must be assigned and the information entered in the “Standards Definitions” table before the standard is assigned an S#.

Obtain a Certificates of Analysis from the vendor of each source standard. Label the certificate with the LIMS S# and the date received and file the certificate in the 3-ring binder.

Source standards usually have an expiration date set by the manufacturer. If no expiration date is listed, the expiration date is one year from date received. Label each vial with the contents, LIMS SS#, and expiration date. Store the standards in a freezer at < -10 °C. *Do not* store standards in a refrigerator or freezer containing samples.

Internal Standard and Surrogate Source Standards:

CT-ISSURR-10	Restek #563334	Internal standard/surrogate	5,000ppm
TFT2000	Restek # 30048	TFT Surrogate	2,000ppm

Primary 8260 Source Standards:

CR-GAS500	Restek # 30042	Custom Gas Mix	2,000ppm
VOACAL-1	Restek # 30006	Ketones Mix	5,000ppm
R-VINYLAC	Restek # 30216	Vinyl Acetate	2,000ppm
2-CLEVE	SPEX-Certiprep # S-855	2-Chloroethylvinylether	2,000ppm
R-CAL2000	Restek # 30431	VOA Mix	2,000ppm
TM4THF	Aldrich # 22,370-0-25g	Tetramethyl-tetrahydrofuran	97%
XQ-1507	SPEX-Certiprep # XQ-1507	Custom VOC Mix	2,000ppm
1CLHEXANE	Accustandard # M-8010R-1-04-10X	1-Chlorohexane	
2,000ppm			
RHEX5000	Restek # 562970	Hexane	5,000ppm
SIODO2K	Accustandard # 5-06052	Iodomethane	
2,000ppm			

Secondary 8260 Source Standards:

S-FR113-2K	Supelco # 4-7944	Freon 113	2,000ppm
AM-502-AR	Accustd # M-502A-R-10X	VOC Mix	2,000ppm
AM-8260-AD	Accustd # M-8260-ADD-10X	Ketones+	2,000ppm
4MTHFICV	Aldrich # 22,370-0-5g	Tetramethyl-tetrahydrofuran	97%
ACCU-VOC	Accustandard # M-502B-10X	Purgeable gases	2,000ppm
S-2190	SpexCertiprep	Extra compounds	
1,000ppm			

Secondary GasOx Source Standards:

RGASOX2000	Restek # 30465	Gasoline Oxygenates Mix	2,000ppm
CT-V421	SPEX-Certiprep # CT-V421	IPA/THF/Eth/Cyclohexanone	20/200 mg/mL

Additional & Alternate Standards:

1-CLHEX	Aldrich # 23,846-5	1-Chlorohexane	99%
S-2190	SPEX Certiprep # S-2190	Hexane	1,000ppm

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MITCYANATE Aldrich # 45576
603-XM-MIX SPEXCertiprep # 603-XM

Methyl isothiocyanate (MITC) 250mg
Acrolein/Acrylonitrile 2,000ppm

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REAGENTS

Label all reagents with the date opened or aliquotted. Use or discard within 1 year, or sooner if problems are encountered.

Methanol, Purge & Trap Grade
Burdick & Jackson, VWR Catalog # BJ232-1
Store in a flammables cabinet for up to 1 year.

PFTBA, Perfluorotributylamine
Agilent Catalog # 8500-8130
Used for instrument auto-tune

APPENDIX_3: PROBLEMATIC SAMPLES

Sample Vial Issues:

It is important to check the sample vials prior to loading them on the autosampler to prevent autosampler errors and instrument downtime. Check the VOA vial label, making sure it is flat and smooth on the vial and that the label won't interfere in the autosampler tray. It may be necessary to label the vial with permanent pen and remove the printed labeling.

Check the VOA vial septa to make sure it is a smooth and not bulging or deformed. This may cause an autosampler error or break a sampling probe. It may be necessary to choose a different sampled VOA vial or replace the cap of that VOA vial.

Occasionally clients will send samples with high amounts of sediment. It is *crucial* that the level of sediment in the VOA vial is below the level at which the probe of the autosampler samples. Sampling sediment leads to clogged lines, active sites, and good amount of line replacement. If the vial has no headspace, try centrifuging the vial. If the amount of sediment is still too high or the vial contains headspace, combine two sampled VOA vials and document on the prep log.

Compositing Samples:

Clients frequently send VOA samples in with instructions to composite samples. Methods specify conditions for compositing samples for VOA analyses that minimizes the loss of constituent analytes. Please reference C&T SOP's for procedures related to compositing VOA samples.

Sample Vial Anomalies:

Sample vial anomalies occur whenever vials given the same designation by the client contain different concentrations of target compounds. The scenario is: An analyst analyzes a VOA vial, notices that a lower dilution is needed, makes the appropriate dilution on an unopened vial, and finds that the results are significantly higher or lower than the initial run. If there are no obvious signs of contamination or carryover, dilute and reanalyze a third vial, if possible or the vial that yielded the higher results even if that vial contains headspace. Results will hopefully be consistent. If a third vial is analyzed, if the results match the high result, report the high result, if it matches the low result, report the low result. If we get inconsistent results, report the high result. On the LIMS sample report, add a comment describing the anomalies and the steps that you took to resolve the problem, noting that these anomalies were not from obvious contamination or carryover and that these anomalies are apparently the result of sampling problems in the field.

Charcoal Samples:

Purging Charcoal samples without extracting it first will result in poor internal standard and surrogate recoveries, so extract any charcoal or carbon sample in methanol at a 2x dilution (5g to 10mL); use a 2x dilution since charcoal would absorb most of the methanol used for extraction if a 1x dilution were done. Purge and analyze an aliquot (up to a maximum of 100µL) of the methanol extract and report any targets found. Add a comment on the LIMS sample report describing the matrix of the sample as charcoal.

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Foaming Samples:

If a sample is suspected to foam when purged, bubble an aliquot of the sample in a VOA vial with a pipette bulb and visually check the viscosity of the bubbles produced by the sample. If the bubbles don't break up or fall down the sides of the VOA vial quickly, dilute the sample and bubble the diluted aliquot. Continue until the bubbles break up quickly and determine the lower dilution that is safe for analysis. Performing this little test prior to analysis reduces the danger of a sample foaming over into the system. Note on the report the aliquot amounts tested and the highest aliquot used and determined to be safe upon analysis. On the LIMS sample report, add the narration (via canned comment "foamer") that the sample was diluted for foaming.

Multiphasic Samples:

Inform Client services about the multiphasic nature of the sample(s) received. After contacting the client, Client services will relay to the analyst which phase(s) must be analyzed. Each phase analyzed in a sample is reported as a unique sample. Add a comment on the LIMS sample report describing the matrix of the sample.

Waste and Oil Samples:

All samples designated as wastes by the client (matrix = miscellaneous in LIMS), whether aqueous or not, must be analyzed by weight only. All oil samples are analyzed by weight only.

Wipe Samples:

If we analyze a wipe sample, the IDF must be 5, and the PDF in the method_parms list must also be 5. This is because, in MSVOA, we don't do formal prep data entry on the prep screen, and so the IDF for the run must include both the PDF and IDF. When we analyze a single wipe, the PDF is 5 mL/s, because we are putting 1 sample into an instrument that's calibrated for nominal 5 mL purge.

APPENDIX 4: METHANOL DILUTIONS FOR SOIL-MODE

For soil samples requiring a 50x dilution or greater, make a methanol extraction as described in *Sample Preparation* (Section 6d):

- 1.) Weigh out 10g (\pm 1g) of soil into a scintillation vial.
- 2.) Add 10uL TFT1250
- 3.) Add 10.0mL of Purge-&-Trap grade methanol
- 4.) Vortex for 2 minutes then centrifuge or allow it to settle.
- 5.) Transfer the extract to a 4mL vial and store in the refrigerator at 4°C.
- 6.) Analyze within 14 days of sample collection.

Use the chart below to determine how much of the methanol extract to add to 5mL of Millipore deionized water to make the required dilution. *Caution:* Do not purge more than 200µL MeOH.

Dilution Factor	Extract Volume Add to 5mL DI H ₂ O	Dilution Factor	Extract Volume Add to 5mL DI H ₂ O
50	100 µL	500	10 µL
62.5	80 µL	625	8 µL
71.4	70 µL	714	7 µL
83.3	60 µL	833	6 µL
100	50 µL	1,000	5 µL
125	40 µL	2,000	2.5 µL
167	30 µL	2,500	2 µL
200	25 µL	5,000	1 µL
250	20 µL		
300	15 µL		
400	12.5 µL		

If less than 1 µL is required for the necessary dilution, make a serial dilution as follows:

SERIAL DILUTIONS of Methanol Extracts

Dilution Factor	Volume (µL) of Extract Added to 5mL	Using MeOH Dilution
10,000 x	50	100 x
50,000 x	50	500 x
100,000 x	50	1,000 x
500,000 x	10	1,000 x
1,000,000 x	5	1,000 x

Note: Dilutions of < 25x are made by using smaller aliquots of soil. Weigh out 2.5g for a 2x dilution or 1.0g for a 5x dilution. A 10x dilution can be prepared by weighing 0.50g (\pm 0.05g).

After dilutions or soil samples have been aliquotted into labeled vials, check the new vial label against the job sheet to ensure the correct samples are loaded. After the sequence has run, check the sequence against the autosampler tray – if any errors are found, start a CAR and do a full investigation to verify which sample was actually run. Update the LIMS sequence and add this CAR# to the LIMS sequence as comment to document what was changed and why.

APPENDIX_5: WATER SAMPLE DILUTIONS

For water samples requiring a dilution, use the following table to determine the amount of sample to be injected into a final volume of 50mL, using clean, rinsed Class-A gas tight syringes and volumetric flasks:

Dilution Factor	Sample Volume Using 50mL volumetric	Dilution Factor	Sample Volume Using 50mL volumetric
1.25	40 mL	71.4	700 µL
1.42	35 mL	83.3	600 µL
2	25 mL	100	500 µL
2.5	20 mL	125	400 µL
3.33	15 mL	142	350 µL
4	12.5 mL	167	300 µL
5	10 mL	200	250 µL
6.25	8 mL	250	200 µL
7.14	7 mL	333	150 µL
8.33	6 mL	400	125 µL
10	5 mL	500	100 µL
12.5	4 mL	625	80 µL
14.2	3.5 mL	714	70 µL
16.7	3 mL	833	60 µL
20	2.5 mL	1,000	50 µL
25	2 mL	2,000	25 µL
33.3	1.5 mL	2,500	20 µL
40	1.25 mL	5,000	10 µL
50	1 mL	10,000	5 µL
62.5	800 µL	50,000	1 µL

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APPENDIX_6: INSTRUMENT CONDITIONS

Note: These are the current parameters at the printing of this SOP. These parameters may change at the discretion of the analyst to optimize instrument performance.

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Solatek 72 / Tekmar 3100 Configuration (Soil Mode)		HP5890 / 5972MSD Configuration (Soil Mode)	
Trap	Tekmar Purge K (Vocarb 3000)	Column	Restek Rtx-624
Rinse Water Temp.	90 °C		60m x 0.25mm x 1.4 um
Sample Cup Temp.	40 °C	Injector Temp	200 °C
Sample Needle Temp.	60 °C	Aux. Temp	270 °C
Transfer Line Temp.	125 °C	Oven Temp Ramp	50 °C, hold 1 minute
Soil Valve Temp.	125 °C		6 °C /min to 95 °C
Sample Sweep Time	0.50 minutes		15 °C/min to 120 °C
Needle Rinse Volume	7mL		20 °C to 220 °C
Needle Rinse Time	0.75 minutes		Hold 6 minutes
Sample Preheat Time	0.00 minutes	Oven Equilib Time	0.5 minutes
Preheat Stir	Off	Constant Flow	On
Preheat Stir Mode	Spin	Flow Pressure	19.05psi
Preheat Stir Speed	1	Split Ratio	25:1
Purge Time	11.00 minutes	Split Flow	27.5mL/min
Purge Stir	On	Total Flow	32.0mL/min
Purge Stir Mode	Spin	Inlet Mode	Split
Purge Stir Speed	5		
Valve Oven Temp.	150 °C	MS Solvent Delay	4.00 minutes
Transfer Line Temp.	150 °C	Low Mass Scan	35
Sample Mount Temp.	40 °C	High Mass Scan	260
MCS Temp.	40 °C	Threshold	150
MCS Bake Temp	310 °C	Sample #	3
Purge Ready Temp.	35 °C		
Purge Temp.	0 °C	Purge Gas	Helium @ ~40-50mL/min
Turbo Cool Temp.	-20 °C	Carrier Gas	Helium @ 1.1mL/min, controlled by EPC
GC Start	Start of Desorb		
GC Cycle Time	0.00 minutes		
Dry Purge Time	2.00 minutes		
Desorb Preheat Temp.	235 °C		
Desorb Time	2.00 minutes		
Desorb Temp.	240 °C		
Bake Time	10.00 minutes		
Bake Temp.	260 °C		
Cryofocuser	Off		
Standby Temp.	100 °C		
Focus Temp.	-150 °C		
Inject Time	1.00 minutes		
Inject Temp.	180 °C		
Sample Heater	On		
Sample Temp.	40 °C		
ISTD/Surr. Vol. Added	5 µL		

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EST 8100 / Encon Configuration (Soil Mode)		HP5890 / 5972MSD Configuration (Soil Mode)	
Trap	K (Vocarb 3000)	Column	Restek Rtx-624
Sample Volume	5mL		60m x 0.25mm x 1.4 um
Rinse Volume	10mL	Injector Temp	200 °C
#Rinses	0	Detector Temp	280 °C
Soil Preheat Stir	Yes	Oven Temp Ramp	45 °C, hold 1 minute
Stir	Yes		4 °C /min to 55 °C
Syringe Flush	0		8 °C/min to 120 °C
Preheat	Yes		18 °C to 220 °C
Preheat Temp	40		Hold 7 minutes
Preheat Time	1.5	Oven Equilib Time	0.2 minutes
Purge Time	10 minutes	Constant Flow	On
Desorb Time	2 minutes	Flow Pressure	16.5psi
Soil Bake Time	6 minutes	Flow Temp	45 °C
		Inlet Purge Valve	On @ 0.0minutes
Standby Flow	Off		
Drain	On	MS Solvent Delay	4.45 minutes
Bakegas Bypass	Off	Low Mass Scan	35
Anti-Foam	Cont.	High Mass Scan	300
Total GC Time	0 minutes	Threshold	150
Valve Oven	120 °C	Sample #	3
Transfer Line	120 °C		
MORT Ready Temp	50 °C	Purge Gas	Helium @ ~40-50mL/min
MORT Bake Temp	260 °C	Carrier Gas	Helium @ 1.5mL/min, controlled by EPC
Purge Ready Temp	35 °C		
Purge Time	11.0 minutes		
Dry Purge Time	2.0 minutes		
Desorb Preheat Temp.	240 °C		
Desorb Temp.	250 °C		
Desorb Time	2 minutes		
Bake Temp.	260 °C		
Bake Time	10 minutes		
ISTD/Surr. Vol. Added	1 µL		

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MSVOA-5 File Designation: Exxxx

EST 8100 / Encon Configuration		HP6890 / 5972MSD Configuration	
Trap	K (Vocarb 3000)	Column	Restek Rtx-624
Sample Volume	5mL		60m x 0.25mm x 1.4 um
Dilution Factor	No	Injector Temp	200 °C
Rinse Volume	5mL	Detector Temp	270 °C
#Rinses	1	Temp Ramp	45 °C, hold 1 minute
Stir	No		4 °C /min to 55 °C
Syringe Flush	1		8 °C/min to 120 °C
Desorb Time	2 minutes		18 °C to 220 °C
			Hold 7 minutes
Standby Flow	On	Oven Equilib Time	0.2 minutes
Drain	Off	Constant Flow	On
Bakegas Bypass	Off	Flow Pressure	18.5psi
Anti-Foam	Cont	Split Ratio	9.155:1
Total GC Time	0 minutes	Split Flow	10.0mL/min
Valve Oven	130 °C	Total Flow	13.7mL/min
Transfer Line	130 °C	Inlet Mode	Split
MORT Ready Temp	50 °C		
MORT Bake Temp	260 °C	MS Solvent Delay	4.20
Purge Ready Temp	35 °C	Low Mass Scan	35
Purge Time	11 minutes	High Mass Scan	300
Dry Purge Time	2 minutes	Threshold	150
Desorb Preheat Temp.	245 °C	Sample #	3
Desorb Temp.	250 °C		
Desorb Time	2 minutes	Purge Gas	Helium @ ~40-50mL/min
Bake Temp.	260 °C	Carrier Gas	Helium @ 1.1mL/min, controlled by EPC
Bake Time	10 minutes		
ISTD/Surr. Vol. Added.	1 µL		

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MSVOA-6 File Designation: Fxxxx

Solatek 72 / Tekmar 3100 Configuration (Water Mode)		HP5890 / 5972MSD Configuration (Water Mode)	
Trap	Tekmar Purge K (Vocarb 3000)	Column	Restek Rtx-624 60m x 0.25mm x 1.4 um
Rinse Water Temp.	90 °C	Injector Temp	200 °C
Sample Cup Temp.	30 °C	Detector Temp	280 °C
Sample Needle Temp.	40 °C	Oven Temp Ramp	40 °C, hold 3 minute
Transfer Line Temp.	125 °C		4 °C/min to 55 °C
Soil Valve Temp.	125 °C		8 °C/min to 120 °C
Sample Sweep Time	0.50 minutes		18 °C to 220 °C
Needle Rinse Volume	10mL		Hold 7 minutes
Needle Sweep Time	0.50 minutes	Oven Equilib Time	0.2 minutes
Bake Rinse Volume	7mL	Constant Flow	On
Bake Sweep Time	0.50 minutes	Flow Pressure	17.6psi
Bake Drain Time	0.30 minutes	Flow Temp	40 °C
Number of Bake Rinses	1	Inlet Purge Valve	On @ 0.0minutes
Valve Oven Temp.	150 °C		
Transfer Line Temp.	150 °C	MS Solvent Delay	4.00 minutes
Sample Mount Temp.	90 °C	Low Mass Scan	35
MCS Temp.	40 °C	High Mass Scan	300
MCS Bake Temp	310 °C	Threshold	150
Purge Ready Temp.	35 °C	Sample #	3
Purge Temp.	0 °C		
Turbo Cool Temp.	-20 °C	Purge Gas	Helium @ ~40-50mL/min
GC Start	Start of Desorb	Carrier Gas	Helium @ 1.5mL/min, controlled by EPC
GC Cycle Time	0.00 minutes		
Sample Heater	Off		
Sample Temp.	40 °C		
Sample Preheat Time	0.00 minutes		
Purge Time	11.00 minutes		
Dry Purge Time	4.00 minutes		
Desorb Preheat Temp.	215 °C		
Desorb Time	2.00 minutes		
Desorb Temp.	220 °C		
Bake Time	10.00 minutes		
Bake Temp.	270 °C		
Cryofocuser	Off		
Standby Temp.	100 °C		
Focus Temp.	-150 °C		
Inject Time	1.00 minutes		
Inject Temp.	180 °C		
ISTD/Surr. Vol. Added	5 µL		

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MSVOA-7 File Designation: Gxxxx

EST 8100/ Encon Configuration		HP5890 / 5973MSD Configuration	
Trap	K (Vocarb 3000)	Column	Restek Rtx-624
Sample Volume	5mL		60m x 0.25mm x 1.4 um
Rinse Volume	5mL	Injector Temp	200 °C
#Rinses	0	Detector Temp	270 °C
Soil Preheat Stir	Yes	Temp Ramp	45 °C, hold 1 minute
Stir	Yes		4 °C /min to 55 °C
Syringe Flush	0		8 °C/min to 120 °C
Preheat	Yes		18 °C to 220 °C
Preheat Temp	40		Hold 7 minutes
Preheat Time	1.5	Oven Equilib Time	0.2 minutes
Purge Time	10 minutes	Constant Flow	On
Desorb Time	2 minutes	Flow Pressure	18.62psi
Soil Bake Time	6 minutes	Split Ratio	33:1
Standby Flow	On	Split Flow	36.3mL/min
Drain	On	Total Flow	40.4mL/min
Bakegas Bypass	Off	Inlet Mode	Split
Anti-Foam	Cont.	MS Solvent Delay	3.80 minutes
Total GC Time	0 minutes	Low Mass Scan	35
Valve Oven	130 °C	High Mass Scan	260
Transfer Line	130 °C	Threshold	250
MORT Ready Temp	50 °C	Sample #	3
MORT Bake Temp	260 °C	Purge Gas	Helium @ ~40-50mL/min
Purge Ready Temp	35 °C	Carrier Gas	Helium @ 1.1mL/min, controlled by EPC
Purge Time	11.0 minutes		
Dry Purge Time	2.0 minutes		
Desorb Preheat Temp.	255		
Desorb Temp.	260		
Desorb Time	1.0 minutes		
Bake Temp.	270		
Bake Time	10 minutes		
ISTD/Surr. Vol. Added.	1 µL		

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MSVOA-8 File Designation: Hxxxx

AquaTek70 / Tekmar 3100 Configuration		HP6890 / 5972MSD Configuration	
Trap	Tekmar Purge K (Vocarb 3000)	Column	Restek Rtx-624 60m x 0.25mm x 1.4 um
Line Temp	150 °C	Injector Temp	220 °C
Valve Temp	150 °C	Aux. Temp	280 °C
Mount Temp	90 °C	Oven Temp Ramp	45 °C, hold 1 minute
MCS Line Temp	40 °C		4 °C /min to 55 °C
Purge Ready Temp	35 °C		8 °C/min to 120 °C
Purge Temp	0 °C		18 °C to 220 °C
Sample Heater	Off		Hold 8 minutes
Purge Time	11 minutes	Oven Equilib Time	0.2 minutes
Dry Purge Time	4 minutes	Constant Flow	On
GC Start Option	Start of Desorb	Flow Pressure	17.93psi
Cryo Focuser	Off	Split Ratio	10:1
Desorb Preheat Temp	200 °C	Split Flow	11.0mL/min
Desorb Time	2.0	Total Flow	14.8mL/min
Desorb Temp	240 °C	Inlet Mode	Split
Bake Time	10 minutes		
Bake Temp	260 °C	MS Solvent Delay	4.30
Bake Gas Bypass	Off	Low Mass Scan	35
MCS Bake Temp	300 °C	High Mass Scan	300
Pressurize Time	0.2 minutes	Threshold	150
Fill IS	0.04 minutes	Sample #	3
Xfer IS	0.5 minutes		
Rinse Lines	0.25 minutes	Purge Gas	Helium @ ~40-50mL/min
Purge Lines	0.50 minutes	Carrier Gas	Helium @ 1.1mL/min,
Bake Rinse	0.75 minutes		
Bake Transfer	0.75 minutes		
Rinse Cycles	2		
Fill IS	On		
AquaTek70	On		
ISTD/Surr. Vol. Added	2 µL		

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MSVOA-9 File Designation: Ixxxx

AquaTek70 / Tekmar 3100 Configuration		HP5890 / 5972MSD Configuration	
Trap	Tekmar Purge K (Vocarb 3000)	Column	Restek Rtx-624 60m x 0.25mm x 1.4 um
Line Temp	150 °C	Injector Temp	200 °C
Valve Temp	150 °C	Detector Temp	280 °C
Mount Temp	90 °C	Oven Temp Ramp	40 °C, hold 2 minute 4 °C /min to 55 °C 8 °C/min to 120 °C 25 °C to 220 °C Hold 5 minutes
MCS Line Temp	40 °C	Oven Equilib Time	0.5 minutes
Purge Ready Temp	35 °C	Constant Flow	On
Purge Temp	0 °C	Flow Pressure	16.9psi
Sample Heater	Off	Flow Temp	40 °C
Purge Time	10 minutes	Inlet Purge Valve	On @ 0.0minutes
Dry Purge Time	4 minutes	MS Solvent Delay	3.80 minutes
GC Start Option	Start of Desorb	Low Mass Scan	35
Cryo Focuser	Off	High Mass Scan	300
Desorb Preheat Temp	200 °C	Threshold	250
Desorb Time	1.5	Sample #	3
Desorb Temp	250 °C	Purge Gas	Helium @ ~40-50mL/min
Bake Time	10 minutes	Carrier Gas	Helium @ 1.5mL/min, controlled by EPC
Bake Temp	260 °C		
Bake Gas Bypass	Off		
MCS Bake Temp	300 °C		
Pressurize Time	0.2 minutes		
Fill IS	0.04 minutes		
Xfer IS	0.5 minutes		
Rinse Lines	0.25 minutes		
Purge Lines	0.50 minutes		
Bake Rinse	0.75 minutes		
Bake Transfer	0.50 minutes		
Rinse Cycles	2		
Fill IS	On		
AquaTek70	On		
ISTD/Surr. Vol. Added	2 µL		

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MSVOA-10 File Designation: Jxxxx

AquaTek70 / Tekmar 3100 Configuration		HP5890 / 5972MSD Configuration	
Trap	Tekmar Purge K (Vocarb 3000)	Column	Restek Rtx-624 60m x 0.25mm x 1.4 um
Line Temp	150 °C	Injector Temp	250 °C
Valve Temp	150 °C	Detector Temp	280 °C
Mount Temp	90 °C	Oven Temp Ramp	45 °C, hold 1 minute
MCS Line Temp	40 °C		4 °C /min to 55 °C
Purge Ready Temp	35 °C		8 °C/min to 120 °C
Purge Temp	0 °C		18 °C to 220 °C
Sample Heater	Off		Hold 7.5 minutes
Purge Time	11 minutes	Oven Equilib Time	0.2 minutes
Dry Purge Time	2 minutes	Constant Flow	On
GC Start Option	Start of Desorb	Flow Pressure	16.9psi
Cryo Focuser	Off	Flow Temp	40 °C
Desorb Preheat Temp	240 °C	Inlet Purge Valve	On @ 0.0minutes
Desorb Time	1.5		
Desorb Temp	250 °C	MS Solvent Delay	4.35 minutes
Bake Time	10.5 minutes	Low Mass Scan	35
Bake Temp	270 °C	High Mass Scan	300
Bake Gas Bypass	Off	Threshold	250
MCS Bake Temp	300 °C	Sample #	3
Pressurize Time	0.2 minutes		
Fill IS	0.03 minutes	Purge Gas	Helium@~40-50mL/min
Xfer IS	0.5 minutes	Carrier Gas	Helium@1.5mL/min, controlled by EPC
Rinse Lines	0.25 minutes		
Purge Lines	0.50 minutes		
Bake Rinse	0.75 minutes		
Bake Transfer	0.50 minutes		
Rinse Cycles	2		
Fill IS	On		
AquaTek70	On		
ISTD/Surr. Vol. Added	2 µL		

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MSVOA-11 File Designation: Kxxxx

AquaTek70 / Velocity XPT Configuration		HP5890 / 5975MSD Configuration	
Trap	Tekmar Velocity K (Vocarb 3000)	Column	Restek Rtx-624 60m x 0.25mm x 1.4 um
Transfer Line Temp	150 °C	Injector Temp	200 °C
Oven Valve Temp	150 °C	Aux. Temp	270 °C
Sample Mount Temp	90 °C	Oven Temp Ramp	50 °C, hold 1 minute 6 °C /min to 95 °C
Purge Ready Temp	45 °C		15 °C/min to 120 °C
DryFlow Standby Temp	150 °C		20 °C to 220 °C
Standby Flow	10 mL/min.		Hold 6 minutes
Pressurize Time	0.25 minutes	Oven Equilib Time	0.2 minutes
Fill I.S. Time	0.04 minutes	Constant Flow	On
Sample Transfer Time	0.25 minutes	Flow Pressure	19.05psi
Pre-Purge Time	0.00 minutes	Split Ratio	25:1
Pre-Purge Flow	40mL/min	Split Flow	27.5mL/min
Sample Heater	Off	Total Flow	32.0mL/min
Sample Preheat Time	0.00 minutes	Inlet Mode	Split
Preheat Temp.	35 °C		
Purge Time	11.00 minutes	MS Solvent Delay	4.00 minutes
Purge Temp.	0 °C	Low Mass Scan	35
Purge Flow	40mL/min	High Mass Scan	260
Purge Rinse Time	0.25 minutes	Threshold	150
Purge Line Time	0.25 minutes	Sample #	3
Dry Purge Time	0.50 minutes		
Dry Purge Temp	40 °C	Purge Gas	Helium @ ~40-50mL/min
Dry Purge FLOW	200mL/min	Carrier Gas	Helium @ 1.1mL/min, controlled by EPC
GC Start	Start of Desorb		
Desorb Preheat Temp.	245 °C		
Desorb Drain	On		
Desorb Time	1.00 minutes		
Desorb Temp.	250		
Desorb Flow	200mL/min		
Bake Rinse	On		
Number of Bake Rinses	3		
Bake Drain Time	0.50 minutes		
Bake Drain Flow	400mL/min		
Bake Time	9.00 minutes		
Bake Temp.	270 °C		
DryFlow Bake Temp.	270 °C		
Bake Flow	400mL/min		
Focus Temp	-150 °C		
Inject Time	1.00 min.		
Inject Temp.	180 °C		
Standby Temp.	100 °C		
ISTD/Surrogate Vol. Added	2 µL		

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MSVOA-12 File Designation: Lxxxx

EST 8100 / Encon Configuration		HP6890 / 5975MSD Configuration	
Trap	K (Vocarb 3000)	Column	Restek Rtx-624
Sample Volume	5mL		60m x 0.25mm x 1.4 um
Rinse Volume	5mL	Injector Temp	250 °C
#Rinses	0	Aux. Temp	270 °C
Soil Preheat Stir	Yes	Oven Temp Ramp	50 °C, hold 3 minute
Stir	Yes		12.5 °C /min to 100 °C
Syringe Flush	0		15 °C/min to 220 °C
Preheat	Yes		Hold 8 minutes
Preheat Temp	40	Oven Equilib Time	0.2 minutes
Preheat Time	1.5	Constant Flow	On
Purge Time	10 minutes	Flow Pressure	17.47psi
Desorb Time	2 minutes	Split Ratio	30:1
Soil Bake Time	6 minutes	Split Flow	30.0mL/min
		Total Flow	33.8mL/min
Standby Flow	On	Inlet Mode	Split
Drain	On		
Bakegas Bypass	Off	MS Solvent Delay	4.00 minutes
Anti-Foam	Cont	Low Mass Scan	35
Total GC Time	0.0	High Mass Scan	260
Valve Oven	130 °C	Threshold	150
Transfer Line	130 °C	Sample #	3
MORT Ready Temp	50 °C		
MORT Bake Temp	260 °C	Purge Gas	Helium @ ~40-50mL/min
Purge Ready Temp	35 °C	Carrier Gas	Helium @ 1.1mL/min
Purge Time	11 minutes		controlled by EPC
Dry Purge Time	2 minutes		
Desorb Preheat Temp.	255 °C		
Desorb Temp.	260 °C		
Desorb Time	1 minute		
Bake Temp.	270 °C		
Bake Time	10 minutes		
ISTD/Surr. Vol. Added	1 µL		

APPENDIX_7: MAINTENANCE & TROUBLE-SHOOTING

Instrument maintenance must be documented in the maintenance benchbook. If preventative or trouble-shooting maintenance is performed, document:

- 1.) Date (mm/dd/yy) and initials of the analyst performing the maintenance
- 2.) Reason the maintenance was necessary
- 3.) Action taken ("changed column", column description, etc.)
- 4.) Resolution of the maintenance ("passed tune", "2-Cleve response back", etc.).

If an outside contractor performed the maintenance, file the laboratory copy of the contractor receipt in the three-ringed binder titled GC/MS-VOC Instrument Maintenance Contractor Receipts. The three-ringed binder is separated by instrument.

Problem: High Background Signal

Do a spectrum scan to try to determine the source of the background signal.

- m/z 28: Nitrogen. Most likely source is a leak at the detector nut.
- m/z 31: Methanol. Were detector parts dried properly prior to installation?
- m/z 44: Carbon Dioxide. Most likely source is a leak at the detector nut.
- m/z 69 plus 219 & 502: PFTBA. The tuning solution reservoir was not closed after tuning.
- m/z 207 or 281: Siloxanes. Septum bleed or column bleed.
- m/z 446: Diffusion Pump Oil. Improper venting pulled oil into the detector. Call Agilent or Full Spectrum for assistance.
- Series of mass peaks 14amu apart, with abundance decreasing with increasing mass: Fingerprint oils on the source or detector end of the column.

Problem: Can't reach full vacuum

Probably a leak. Scan for m/z from 0 to 50 amu and look for water (18), nitrogen (28), and oxygen (32). If present, there's probably a leak around column-to-source connection. You can also use dust-cleaner to search for leaks by scanning for the primary ion of the main chemical in the dust-cleaner. If the abundance of that ion increases as you spray sections of the MS, then there is a leak. Check fitting and ferrule. If snug, ferrule is probably scored and should be replaced. Also check cal-gas valve.

Check Purge Flow (Tekmar 3100)

- 1.) Step the 3100 to Purge.
- 2.) Attach the flow meter end to the 3100 vent.
- 3.) Wait ~3minutes for purge flow to stabilize.
- 4.) Record the flow rate.

Backflush for Tekmar 3100

1. Keep the instrument power on and turn the line heaters off. Set all temperatures to the off position and wait until the heated zones have cooled.
2. Make sure the unit is in standby mode.
3. Disconnect the purge vessel and trap.
4. Flush Methanol into the area where the top of the trap attaches, using a 5mL luer-lock syringe and fittings. This is the area where the purge vessel attaches to the purge and trap. You should see Methanol coming out from the mount. Repeat 3-5 times.

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5. Clean the mount, using a kim-wipe. Be careful not to scratch the mount. If the mount cannot be cleaned, replace the mount.
6. Clean the purge vessel with Methanol then D.I. water. Do not use soap.
7. Increase purge and trap temperatures to normal operating conditions and hold for two hours, without the trap or purge vessel installed.
8. Disconnect the transfer line from the GC inlet.
9. Install the purge vessel, all lines, and an old used trap.
10. Desorb for at least 1 hour with the transfer line removed.
11. Install the new trap, condition it, and run instrument blanks until a clean baseline is achieved.

Changing the column:

The column should be changed whenever: 1.) the first analyte can not be separated from the solvent peak, 2.) target compounds with similar primary ions can no longer be resolved from each other, 3.) an initial calibration will not meet requirements and the purge and trap has been ruled out. Injection port maintenance and source cleaning should be done each time the column is changed in order to minimize down-time.

1. Use the Chemstation *INSTRUMENT CONTROL*: Vacuum Control to vent the instrument. Then turn off the oven, injector port, and detector port temperatures, and shut off the MSD and the vacuum pump.
2. Allow all parts to cool to room temperature.
3. Use the GC keypad to set the inlet pressure or column flow to zero.
4. Remove the old column from the injection and detector ports and cap the column with a septum.
5. Confirm the column type and product I.D. Then clip each end of the new column according to manufacturer's specifications.
6. Put the injector port nut and a graphite ferrule on one end of the new column, then clip about 3 or 4 centimeters off the end of the column. Hold the column at a slight downward angle when cutting the column, so that any small chips will not fall back into the column.
7. Place a mark (with white-out or a felt-tip marker) or septa between 10-12mm from the end of the column or such that there is ~5mm of column between column end and the ferrule.
8. Insert the column into the injection port so that the lower end of the injection port nut lines up with the mark. Tighten the nut to finger-tight, then wrench-tighten until snug, making sure the mark still lines up with the end of the nut.
9. Clip about 3 or 4 centimeters off of the detector the end of the column.
10. Use the GC keypad to turn the carrier gas back by entering "Constant Flow" "ON".
11. Use the GC keypad to set injector port temperature to 200°C.
12. Set the oven temperature to 220°C and bake out the column, without installing it in the detector, while you clean the source (or at least 2-3 hours).
13. After cooling the oven back to room temperature, put a new source nut and a vespel/graphite ferrule on the detector port end of the column. Never use a pure graphite ferrule on the detector end of the column as it may contaminate the source.
14. Slowly and carefully, insert the column into the detector just past the end of the GC/MS interface, then pull it back about 2 millimeters (so that tightening the nut will not crush the end of the column).
15. Tighten the nut to finger-tight, then wrench-tighten to snug.
16. Turn on the rough pump and the MSD.

17. Use the *INSTRUMENT CONTROL*: Vacuum Control options to pump down the MSD. Check the status of the instrument; once the status is "OK" (usually ~70mtorr), turn on the proper detector temperature, and do a spectrum scan to check for leaks.
18. Bake out over-night to remove any remaining moisture from the detector. The next morning, mass 28 should be less than 10% of mass 69 in the PFTBA; if higher levels are observed, the injector or detector ends of the column may need to be re-installed.

Document in the maintenance log what the symptoms were that prompted you to change the column, when you changed it, and whether or not the new column eliminated the symptoms.

Cleaning the source:

The source should be cleaned whenever 1.) the column is changed, 2.) tuning criteria can not be met, or 3.) no response is obtained from either filament. 4.) an initial calibration will not meet requirements and the purge and trap has been ruled out.

To clean source

1. Vent MS, power down, and cool GC. Check instructions for pump shutdown.
2. Remove column and interface from MS
3. Need to protect interface insertion surface. Remove it from the analyzer and wrap in foil until analyzer needs to go back into MS.
4. Remove source and take to clean area to work.
5. Remove the control interface cables, electrical connections to the filament, the repeller, and focus lenses.
6. Remove retaining screws that holds the filaments and the repeller to the source body. (On HP5972, source assembly can be removed up to entrance lens as a single piece.)
7. The pieces that need cleaning are: repeller face, ion source inner body, both sides of the draw-out plate and its pinhole entrance, focus lens, and entrance lens contact surfaces. (Ion source body shows burn next to where it contacts the filaments. This needs to be removed and holes leading to source body need to be cleaned by reaming with a fine drill.
8. Find out the best material to clean the source.
9. Once clean. Use cotton gloves to inspect pieces.
10. Assembly is reverse of disassembly. (Make sure ceramic collar between the source and the quadrupole does not bind. It must turn freely.)
11. When assembled, check continuity of the electrical.
12. Re-insert analyzer into the MS body.
13. Reconnect the interface and reinsert the column using the proper insertion length.
14. Replace housing on the vacuum containment vessel and turn on rough pump.
15. Set interface heater to operating temp., set up GC temps to startup.
16. At 10^{-4} torr, turn on other pump. READ INSTRUCTIONS ON PUMP FIRST. If you can't achieve 10^{-4} torr, push down on lid of containment vessel.
17. Once full vacuum is reached, check for leaks by scanning below 50 amu.
18. Rerun autotune and check height of the m/z 502 peak.

Document in the maintenance log what the symptoms were that prompted you to clean the source, when you cleaned it, and whether or not the cleaning eliminated the symptoms.

To clean quadrupole rods

1. Vent the system and remove the source.
2. Remove the ceramic collar between the source and the electrical connections.

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3. Removed rod package (the rods are held in place by two ceramic collars. DO NOT REMOVE THESE COLLARS)
4. Immerse complete quadrupole unit in their ceramic collar in graduated cylinder and flood with solvent.
5. Use care as to not chip rods.
6. Wash with Hexane, then CH₂Cl₂, and finally with Acetone.
7. Air Dry and then place in desiccator.
8. Replace into MS.
9. Evacuate the rods in the MS.

Changing the rough pump oil:

The oil in the “rough” vacuum pump should be changed every 6 months, or when it becomes brown & cloudy.

1. Follow Steps 1 through 5 above to shut down the instrument.
2. Allow the pump to cool then unplug the rough pump
3. Disconnect the hose from the rough pump.
4. Drain the oil into the waste oil container and replace it with fresh vacuum pump oil (Scientific Instrument Supply, Catalog # INV45-1).
5. Reconnect the hose to the rough pump and turn on the rough pump.
6. Turn on the MSD and download the detector port, injector port, and oven temperatures.
7. Use the *INSTRUMENT CONTROL* options to check the vacuum status. Once the status is “OK” (usually ~200mtorr), do a spectrum scan to check for hydrocarbon background; if the background is very noisy, the detector may need to be baked out.
8. Document the maintenance in the benchbook.

Changing the Electron Multiplier:

1. If noise increases, run the repeller to the max value.
2. Look at electron multiplier voltage needed to achieve the benchmark value for the 502 fragment.
3. When EM voltage is above 3500V, replace the multiplier.

System grounding

Problems with gas peaks failing to stabilize? Have a good calibration but can't hold a tune? It may be due to lack of grounding. Try connecting the MS chassis and the controlling interface together with a grounding strap. Use a common surge protector for all electrical and the computer system.

**APPENDIX 8: BFB TUNE
& CALIBRATION VERIFICATION (ICV/CCV) CRITERIA**

Mass (m/z)	BFB Ion Abundance Criteria
50	15 to 40% of mass 95
75	30 to 60% of mass 95
95	base peak, 100% relative abundance
96	5 to 9% of mass 95
173	less than 2% of mass 174
174	greater than 50% of mass 95
175	5 to 9% of mass 174
176	greater than 95% but less than 101% of mass 174
177	5 to 9% of mass 176

Tune acceptance is based on a single scan, average of two consecutive scans, or average of three consecutive scans; background subtraction is required per the method. If the BFB does not pass using these options, another BFB should be analyzed. If that also fails, instrument maintenance should be performed to correct the problem. *No sample data associated with a failing tune standard may be reported.*

Calibration Verification (ICV & CCV) Criteria:

An ICV (Initial Calibration Verification) standard is analyzed as part of the instrument calibration procedure described in [Appendix 9](#) below. This standard must meet the same acceptance criteria required for the CCV (Continuing Calibration Verification) standard as described below.

A CCV (Continuing Calibration Verification) standard is analyzed at the beginning of each 12-hour shift after the BFB has passed tune, to verify that the response of the instrument has not changed significantly and that the curve may still be used to quantitate sample results. Use a standard at one of the three middle levels of the calibration curve, not at either extreme (highest or lowest point) of the ICAL curve. The standard concentration used for the CCV should be alternated over the course of several tune shifts.

- 1.) Examine the Form 7 against the following criteria to determine whether the CCV is acceptable:
 - a.) The retention times should increase with assigned 'compound number' (in the acquisition software). The compound spectra should be re-examined for any Rt's that appear out of order.
 - b.) All compounds must meet minimum relative response factor (RRF) of 0.05.
 - c.) System Performance Check Compounds (**SPCC**) RRF must be:
 - RRF \geq 0.3: 1,1,2,2-Tetrachloroethane
Chlorobenzene
 - RRF \geq 0.1: Chloromethane
1,1-Dichloroethane
Bromoform

d.) Calibration Check Compounds (**CCC**) %D must be $\leq 20\%$ from the initial calibration.

%D ≤ 20 : Vinyl Chloride
1,1-DCE
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene

e.) **Non-CCC** compounds %D must be $\leq 30\%$, except for poor performers (such as vinyl acetate, 2-chloroethyl-vinylether, etc.) which must be $\leq 40\%$.

624 Method Note: EPA 624 does not discuss minimum response requirements or differentiate between various types of analytes. The recoveries must meet those listed in Table 5 of the method, however the criteria listed in a.) through e.) above are tighter than those listed in the method and should be used for routine analysis.

Method 8260C Note: Method 8260C specifies minimum response factors for about 40 different compounds in Table 4 of the method page 44-45. When performing this method in strict compliance with 8260C (DoD work) check minimum response factors for compounds. Find a copy of Method 8260C posted on the LIMS: Main Page\SOPs&Methods\Methods.

- 2.) If any of the above criteria are not met, examine the integration to verify that each peak was correctly integrated. Manual integrations must be consistently applied to ICAL, CCV, and sample integrations. **Unsubstantiated alteration of peak integration solely to pass calibration or QC criteria is illegal and is grounds for immediate termination.** If the SPCC and CCC criteria are not met, another CCV standard should be analyzed, unless reporting a single analyte or small set of analytes. In these cases, those target analytes must each pass SPCC and CCC criteria. If the second analysis of the standard also fails to meet the SPCC and CCC criteria, recalibration and/or other instrument maintenance is required. See Appendix_9 for the Initial Calibration procedure and acceptance criteria.
- 3.) If two CCV's were analyzed, "x" out the first CCV, set the second to stype "CCV" and process the data from the second CCV. Do not "cherry pick" some compounds from the first CCV and others from the second CCV; if the second CCV is processed and used, all compounds must be taken from the second standard.
- 4.) If the SPCC and CCC criteria are met, but other compounds fail acceptance criteria, data may be reportable based on the following:
 - a.) If the failing compound is not a target analyte for the associated samples, sample results should be reported without reanalysis.
 - b.) If the compound fails the minimum RRF (0.05) requirement and is a required target compound for the sample, the sample must be reanalyzed.
 - c.) If the compound fails the %D criterion due to a high response but was not detected above the reporting limit in the associated samples, the sample results may be reported without reanalysis, as the high bias does not affect the sample results.

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- d.) If the compound fails the %D criterion due to a high response and *was* detected above the reporting limit in any of the associated samples, the samples must be reanalyzed.
- e.) If the compound fails the %D criterion due to a low response and *was* detected (even below the reporting limit), the sample must be reanalyzed.
- f.) If the compound meets minimum RF, but fails the %D criterion due to a low response (but not more than 50% low) and *was not* detected (even below the reporting limit), the sample results may be reported without reanalysis.

APPENDIX_9: INITIAL CALIBRATION PROCEDURE & CRITERIA

Requirements:

An initial calibration curve must be done whenever the source has been cleaned, when a new column has been installed, or when purge-and-trap maintenance has been performed that affects transporting and trapping analytes. In general, a new calibration curve must be made whenever instrument conditions have been altered, or whenever the continuing calibration verification no longer passes acceptance criteria.

The instrument's analytical range must be established by running an initial calibration curve with standards containing all the compounds of interest at a minimum of 5 levels, generally ranging from 0.5 ppb to 100 ppb in concentration. Because lower detection limits are often required for water samples, more levels are analyzed at or near the reporting limit for compounds requiring a reporting limit less than 5 ppb. If a quadratic curve is used, a minimum of six points must be included in the curve.

Note: The lowest point run in both soil and water calibration is at half RL for most of the 8260 compounds. This is for two reasons and will be explained using water calibration reporting levels. The first reason is to establish a reporting limit for Vinyl Chloride at 0.5ppb, where the reporting limit for the other gases is 1.0ppb. The second reason is provide a 0.5ppb reporting limit for m,p-xylene. Since these isomers can not be separated and detected from each other on the GC/MS, a mix containing 0.5ppb of both m-xylene and p-xylene would yield 1.0ppb of m,p-xylene. By running the lowest point at 0.25ppb for both m-xylene and p-xylene, a reporting limit of 0.5ppb for m,p-xylene can be established.

The curve must be verified by analyzing an Initial Calibration Verification (ICV) standard comprised of standards obtained from a different manufacturer than those used to prepare the ICAL standards.

See Appendix_1 for calculations of response factor, RSD, and correlation coefficient.

ICAL Sequence:

- 1.) Prepare the standards as described in Appendix_2.
- 2.) Prepare an Initial Calibration Verification (ICV) standard from source standards obtained from a different manufacturer than the ICAL standards.
- 3.) Analyze a BFB Tune Standard. This standard must pass acceptance criteria before the analysis can continue.
- 4.) Analyze a Calibration initial blank (calib ib)
- 5.) Load the calibration standards onto the autosampler tray in order of increasing concentration followed by the ICV and IB.

Note: An acceptable ICV must be analyzed before any samples are loaded. If the ICV does not pass acceptance criteria and samples were analyzed immediately following it, the entire

calibration must be reanalyzed, as there is no way of determining what affect the sample matrix would have on any subsequent ICV analysis.

- 6.) Make sure you acquire the calibration as type: "calib", with the correct level typed into the sequence.

Chemstation/ Target Notes: When entering a sequence in the Chemstation sample log table, click on the arrow under the "type" field near the bottom of the window. Highlight "calibration". This will add more fields to the bottom of the sample log table window. In the "level" field, type in the calibration level. This must be identical to the calibration level entered in Target/Chemstation for each concentration.

- 7.) Use the same Target/Chemstation Processing (data acquisition) method as used for samples (ie: I4M826.m) but first edit the method so that all compounds are using the average response factor for quantitation.

Target Notes: Edit the Target (processing) method by right clicking on the method name (ei: I5M826w.m) under the current day's directory. Choose "edit method" from the options. At the top of the method editor window, under the "Global" heading, click on "calibration". The curve type should be "average". If it is not "average" click on the type and choose "average". Click on "Update Curve Parameters" then "Save"; all compounds should then default to average response. You must update the curve parameters even if the curve type is "average" to ensure that all compounds are updated to average-Rf curves. Clear the calibration table by choosing "File" and "Zero Calib". Save the method. Make sure the "save to source" box is checked.

Chemstation Notes: Edit the Chemstation method by Choosing "Method" and "Load Method" from the title bar in Chemstation. Select the method file you wish to edit. Under "Initial Calibration", choose "Edit Compounds". Clicking on the "+" next to the internal standard name will show all target compounds associated with that internal standard. Highlight the first compound in the list and in the "Quantitation Options" setting of the Windw, make sure the drop down for "Curve Fit" is set to "Average of Response Factors". Scroll down the list and do this for each compound. Clear the calibration by choosing "Initial Calibration" and "Clear All Response Factors". Save the method.

Exit and save the method back to the same name.

- 8.) Write the sequence as below, identifying the type of sample as initial calibration standards, the LIMS identification of the standards, and the applicable dilution factors. This data must be correctly entered into the sequence in a specific order for LIMS to be able to interpret the information and should be written into the sequence as follows:

BFB, S#, 50ng
IB, CALIB IB
ICAL, S_a#, V_s/V_{f_a}, S_b#, V_s/V_{f_b}, Conc₁
ICAL, S_a#, V_s/V_{f_a}, S_b#, V_s/V_{f_b}, Conc₂
ICAL, S_a#, V_s/V_{f_a}, S_b#, V_s/V_{f_b}, Conc₃
ICAL, S_a#, V_s/V_{f_a}, S_b#, V_s/V_{f_b}, Conc₄
ICAL, S_a#, V_s/V_{f_a}, S_b#, V_s/V_{f_b}, Conc₅

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ICAL, S_a#, V_s/V_f_a, S_b#, V_s/V_f_b, Conc₆
ICAL, S_a#, V_s/V_f_a, S_b#, V_s/V_f_b, Conc₇
ICV, S_a#, V_s/V_f_a, S_b#, V_s/V_f_b, Conc

Where:

Conc is the concentration of the standard (ie: 50ppb)
NP means "No Print" the compound spectra
V_s is the volume/ weight (in mL or g) of standard or sample used,
V_f is the final volume of the standard,
(ie: V_s/V_f = 0.02/100 for 20µL standard used, diluted to 100mL),
S# is the LIMS S# of the standard used

If the ICAL standard concentration is exactly some factor times the previous level, the sequence entry may be written as:

ICAL, =ICAL, #x, Conc

Where #x is the multiplication factor to the previous standard (ie: 2x).

- 9.) Files should transfer, process, print, and send the data to LIMS automatically. If you do not want to complete automatic processing of the data, use the following:
- To prevent printing the spectra type "NP" in the miscellaneous line.
 - To process files that have not yet been processed, select the appropriate method file (ie: I4M826.m), toggle each file as a calibration standard, and type the level of the standard in the space provided
 - To view the initial calibration summary form in Target, right click on the method in the target browser and select "edit method", then under "view", choose "initial calibration". In Chemstation, click on "Initial Calibration" and choose "Response Factors to Screen". Check the %RSD for each analyte and edit the method if needed. Once all curves have been chosen for each compound, reprocess the ICAL and send the data files (and the target method if acquired using Target) to LIMS. LIMS will automatically print out a summary form.(See ICAL workup in Appendix_13 for specifics)
Note: When you save to the G: drive in Chemstation, the method is automatically saved to LIMS and does not need to be sent via any utility.

ICAL Acceptance Criteria and Data Review:

After the standards have run, work up the data and create the calibration curve. (See *ICAL Workup* in Appendix_13 for specifics) Once the ICAL is created in LIMS, determine if the curve passes acceptance criteria:

- 10.) *Every* analyte peak in *every* calibration level must be examined for the following:
- The retention times should increase with assigned 'compound number' (in the acquisition software). The compound spectra should be re-examined for any RT's that appear out of order.

- b.) Verify that every compound was detected and selected correctly in each of the standards. Make sure that the same peak was not identified as two analytes, particularly for isomers or other closely eluting compounds.

Note: Don't re-number the analytes, as this allows the reviewers to quickly identify any RT problems. If you must (after adding a new compound, for example), print out the spectra for the compounds that were changed and have them reviewed to confirm that the correct peak was identified

- c.) Verify that the quantitation ions are integrated correctly.

Peaks should be integrated from baseline to baseline unless the ion ratios are not correct, in which case only the part of the peak with the correct ions is integrated. Manual integrations of any kind must be substantiated and documented on the Initial Calibration Report. Manual integrations must be consistently applied to ICAL, CCS, and sample integrations.

Unsubstantiated alteration of peak integration solely to pass calibration criteria is illegal and is grounds for immediate termination. The Target/Chemstation software will flag any manually integrated compounds with an "m" on the quant report next to the concentration for that compound; this flag must be initialed by the analyst. Copies of any manually integrated spectra must be included in the ICAL data package. In addition the analyst must document the reason on the data. All manual integrations must be documented for DoD clients. The initial calibration curve generation and/or instrument maintenance must be repeated until specifications have been achieved. For each manual integration performed, scan a copy of the extracted ion profile chromatogram into LIMS.

- 11.) Review the Initial Calibration Summary to determine whether or not the calibration curve complies with the following acceptance limits:

- a.) All compounds must meet minimum relative response factor (RRF) of 0.05.

- b.) System Performance Check Compounds (**SPCC**) RRF must be:

RRF \geq 0.3: 1,1,2,2-Tetrachloroethane
Chlorobenzene

RRF \geq 0.1: Chloromethane
1,1-Dichloroethane
Bromoform

Method 8260 C specifies minimum response factors for about 40 compounds in Table 4, page 44-45

Calibration Check Compounds (**CCC**) %RSD must be \leq 30%:

%RSD \leq 30: Vinyl Chloride
1,1-DCE
Chloroform
1,2-Dichloropropane
Toluene
Ethylbenzene

If the RSD is > 30% for CCC compounds, the calibration is not acceptable. If the RSD is < 30% but > 15%, linear regression must be used for quantitation.

- c.) For **non-CCC** compounds, the %RSD must be $\leq 30\%$, except poor performers (such as vinyl acetate, 2-chloroethyl-vinylether, etc.), which must be $\leq 40\%$.
- d.) To use the average response factor for quantitation of any compound, the initial calibration RSD must be $\leq 15\%$.
- e.) If the %RSD is > 15%, a linear or quadratic regression must be used for this compound and the correlation coefficient (r^2) must be 0.99 or better.

Use a linear regression as a first option. If, upon visual inspection of the calibration curve, there is an obvious bias at the low end, the analyst may use a quadratic curve so long as there are six or more points in the curve for that compound. Per the 8260B method, the analyst may not use weighting, force through zero, or use (0,0) as a point in the curve to eliminate the low-end bias. For whichever fit is chosen, the correlation coefficient (r^2) must meet the 0.99 criteria. The option selected must be indicated on the ICAL summary. If the %RSD is >30%, it's a good idea to investigate the system to determine if further maintenance is needed.

The low point may be rejected only for compounds that have reporting limits of 5 ppb or more. The high point may be rejected for certain compounds (such as Vinyl Chloride which tends to saturate at high levels) so long as there are at least 5 points remaining for each compound in the ICAL.

If a single point in the curve is causing the failure, the standard may be reanalyzed, if:

- a.) it immediately follows the original calibration runs,
- b.) is still within the same 12-hour tune clock, and
- c.) all compounds are calibrated using the second run.

Under no circumstances may a point in the middle of the curve be rejected in order to pass calibration criteria for a particular compound.

624 Method Note: Method 624 does not discuss minimum response criteria or differentiate between types of compounds. It allows use of Average Response so long as the %RSD ≤ 35 , but because most of C&T's current work is by 8260, the calibration should pass the criteria listed in 10.a – 10.e above.

- 12.) Create an ICAL in LIMS and make sure that all manual integrations and linear or quadratic curves are scanned into LIMS. Review the calibration for the above criteria.
- 13.) Examine the LIMS ICAL summary. The %D for recalculated concentrations should be within 20% of the true concentration of the standard.

For any project requiring compliance to DoD QSM v4.1, or method 8260C specifications, the re-quantitation limits are +/- 30% for the low point of the ICAL curve.

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- 14.) Re-quantitate the run for the Initial Calibration Verification (ICV) standard with the newly created method and generate an ICV summary report. All compounds in the ICV should meet CCV criteria. Compounds not meeting this requirement should not be reported from the calibration in question.
- 15.) An acceptable ICV must be analyzed before any samples are loaded. If the ICV does not pass acceptance criteria and samples were analyzed immediately following it, the entire calibration must be reanalyzed, as there is no way of determining what affect the sample matrix would have on any subsequent ICV analysis.

If two ICV's (containing the same analytes) were analyzed, "x" out the first ICV, set the second to stype "ICV" and process the data from the second ICV. Do not "cherry pick" some compounds from the first ICV and others from the second ICV; if the second ICV is processed and used, all compounds must be taken from the second standard.

- 16.) Re-quantitate the run for the calibration blank. Examine carefully to determine if any compound is detected in the blank at a level greater than the lowest point in the curve. If this is the case, the curve should not be used.
- 17.) Send the ICAL for review using the LIMS review application.

APPENDIX 10: C&T STANDARD REPORTING LIMITS

8260 Target Compound List	Low Level Water µg/L	Soil µg/Kg
Freon 12 (Dichlorofluoromethane)	1	10
Chloromethane	1	10
Vinyl Chloride	0.5	10
Bromomethane	1	10
Chloroethane	1	10
Trichlorofluoromethane	1	5
Acetone	10	20
Freon 113	2	5
1,1-Dichloroethene	0.5	5
Methylene Chloride (Dichloromethane)	10	20
Carbon Disulfide	0.5	5
MTBE (Methyl tert-Butyl Ether)	0.5	5
trans-1,2-Dichloroethene	0.5	5
Vinyl Acetate	10	50
1,1-Dichloroethane	0.5	5
2-Butanone (MEK)	10	10
cis-1,2-Dichloroethene	0.5	5
2,2-Dichloropropane	0.5	5
Chloroform	0.5	5
Bromochloromethane	0.5	5
1,1,1-Trichloroethane	0.5	5
1,1-Dichloropropene	0.5	5
Carbon Tetrachloride	0.5	5
1,2-Dichloroethane	0.5	5
Benzene	0.5	5
Trichloroethene	0.5	5
1,2-Dichloropropane	0.5	5
Bromodichloromethane	0.5	5
Dibromomethane	0.5	5
4-Methyl-2-pentanone (MIBK)	10	10
cis-1,3-Dichloropropene	0.5	5
Toluene	0.5	5
trans-1,3-Dichloropropene	0.5	5
1,1,2-Trichloroethane	0.5	5
2-Hexanone	10	10
1,3-Dichloropropane	0.5	5
Tetrachloroethene	0.5	5
Dibromochloromethane	0.5	5
1,2-Dibromoethane (EDB)	0.5	5
Chlorobenzene	0.5	5
1,1,1,2-Tetrachloroethane	0.5	5
Ethylbenzene	0.5	5

8260 Target Compound List	Low Level Water µg/L	Soil µg/Kg
m,p-Xylenes	0.5	5
o-Xylene	0.5	5
Styrene	0.5	5
Bromoform	1	5
Isopropylbenzene	0.5	5
1,1,2,2-Tetrachloroethane	0.5	5
1,2,3-Trichloropropane	0.5	5
Propylbenzene	0.5	5
Bromobenzene	0.5	5
1,3,5-Trimethylbenzene	0.5	5
2-Chlorotoluene	0.5	5
4-Chlorotoluene	0.5	5
tert-Butylbenzene	0.5	5
1,2,4-Trimethylbenzene	0.5	5
Sec-Butylbenzene	0.5	5
para-Isopropyl toluene	0.5	5
1,3-Dichlorobenzene	0.5	5
1,4-Dichlorobenzene	0.5	5
n-butylbenzene	0.5	5
1,2-Dichlorobenzene	0.5	5
1,2-Dibromo-3-chloropropane	2	5
1,2,4-Trichlorobenzene	0.5	5
Hexachlorobutadiene	2	5
Naphthalene	2	5
1,2,3-Trichlorobenzene	0.5	5

GASOX Target Compound List	Water µg/L	Soil µg/Kg
1,2-Dibromoethane (EDB)	0.5	5
1,2-Dichloroethane (1,2-DCA)	0.5	5
Methyl Tert-Butyl Ether (MTBE)	0.5	5
Tert-Butyl Alcohol (TBA)	10	100
Isopropyl Ether (DIPE)	0.5	5
Ethyl tert-Butyl Ether (ETBE)	0.5	5
Methyl tert-Amyl Ether (TAME)	0.5	5

The following compounds are not included in either the standard 8260 or GASOX compound list but can be calibrated upon request.

Additional Compounds	Water µg/L	Soil µg/Kg
2-Chloroethylvinylether (<i>see Note below</i>)	10	10
Ethanol	2,000	2,000
2-Propanol (IPA)	100	100
Tetrahydrofuran (THF)	100	100
Tetra-methyl THF	5 or 0.5	5
Hexane	5	5
1-Chlorohexane	5	5
Cyclohexanone	100	100
Methyl isothiocyanate (MITC)		

Note: If 2-Chloroethylvinylether is requested, the sample should be submitted in an unpreserved amber VOA vial.

When method development is performed to include an additional compound, the retention time of the target compound should be within 0.8-1.2 relative retention time of the associated internal standard (8260b sect. 7.3.2.2).

APPENDIX_11: QUANTITATION IONS & INTERNAL STANDARD ASSIGNMENTS

<u>Internal Standard</u>	<u>Related Compounds</u>
27.) Pentafluorobenzene	compounds 1 - 29
36.) 1,4-Difluorobenzene	compounds 30 - 45
55.) Chlorobenzene-d ₅	compounds 46 - 62
78.) 1,4-Dichlorobenzene-d ₄	compounds 63 - 86

Method Modification: EPA 8260B recommends the use of Fluorobenzene as an internal standard, however C&T uses Pentafluorobenzene instead, as it elutes earlier than Fluorobenzene and better represents the early eluting compounds.

<u>Compound</u>	<u>Primary Ion</u>	<u>Secondary Ion(s)</u>	
1.) Freon 12 (Dichlorodifluoromethane) ^a	85	87	
2.) Chloromethane	50	52	
3.) Vinyl Chloride	62	64	
4.) Bromomethane	94	96	
5.) Chloroethane	64	66	
6.) Trichlorofluoromethane ^a	101 ^c	151	153
7.) Ethanol ^a	45 ^c	46	
8.) Freon 113 ^{a, b}	101	151	153
9.) 1,1,-Dichloroethene	96	61	63
10.) Acetone ^a	43 ^c	58	
11.) Isopropanol ^{a, b}	45	43	
12.) Carbon Disulfide ^a	76	78	
13.) Methylene Chloride	84	86	49
14.) tert-Butyl Alcohol (TBA) ^a	59	41	
15.) Methyl tert-Butyl Ether (MTBE) ^a	73	57	
16.) trans-1,2-Dichloroethene	96	61	98
17.) Isopropyl Ether (DIPE) ^b	45	87	43
18.) Vinyl Acetate ^a	43	86	
19.) 1,1-Dichloroethane	63	65	83
20.) Ethyl tert-Butyl Ether (ETBE) ^{a, b}	59	87	57
21.) 2,2-Dichloropropane ^a	77	97	
22.) 2-Butanone ^a	43	72	57
23.) cis-1,2-Dichloroethene ^a	96	61	98
24.) Bromochloromethane ^a	128	49	130
25.) Tetrahydrofuran ^{a, b}	42	72	
26.) Chloroform	83	85	
27.) * Pentafluorobenzene	168		
28.) Dibromofluoromethane (s)	113	111	192
29.) 1,1,1-Trichloroethane	97	99	61

<u>Compound</u>	<u>Primary Ion</u>	<u>Secondary Ion(s)</u>	
30.) Carbon Tetrachloride	117	119	
31.) 1,1-Dichloropropene ^a	75	110	77
32.) 1,2-Dichloroethane-d ₄ (s)	65	67	
33.) Benzene	78	77	
34.) Methyl tert-Amyl Ether (TAME) ^{a, b}	73	87	55
35.) 1,2-Dichloroethane	62 ^d	98	
36.) * 1,4-Difluorobenzene	114		
37.) Trichloroethene	95 ^d	97	132
38.) Trifluorotoluene (s)	146	145	127
39.) 1,2-Dichloropropane	63 ^d	112	
40.) Dibromomethane ^a	93	95	174
41.) Bromodichloromethane	83 ^d	85	127
42.) 2-Chloroethylvinylether	63 ^d	65	106
43.) Tetramethyl THF ^{a, b}	43	70	113
44.) cis-1,3-Dichloropropene	75	77	39
45.) 4-Methyl-2-pentanone ^a	43 ^c	58	100
46.) Toluene-d8 (s)	98	100	
47.) Toluene	92	91	
48.) trans-1,3-Dichloropropene	75	77	39
49.) 1,1,2-Trichloroethane	85 ^{c, d}	83	97
50.) Tetrachloroethene	166 ^{c, d}	164	131
51.) 2-Hexanone ^a	43	58	100
52.) 1,3-Dichloropropane ^a	76	78	
53.) Dibromochloromethane	129 ^d	127	
54.) 1,2-Dibromoethane (EDB) ^a	107	109	188
55.) * Chlorobenzene-d5	117		
56.) Chlorobenzene	112	77	114
57.) Ethylbenzene	91 ^d	106	
58.) 1,1,1,2-Tetrachloroethane ^a	131	133	119
59.) m,p-Xylene ^a	106	91	
60.) o-Xylene ^a	106	91	
61.) Styrene ^a	104	78	
62.) Bromoform	173	175	254
63.) Isopropylbenzene ^a	105	120	
64.) Cyclohexanone ^{a, b}	55		
65.) Bromofluorobenzene (s)	95	174	176
66.) 1,1,2,2-Tetrachloroethane ^a	83 ^d	131	85
67.) Propylbenzene ^a	91	120	
68.) Bromobenzene ^a	156	77	158
69.) 1,2,3-Trichloropropane ^a	75	77	

<u>Compound</u>	<u>Primary Ion</u>	<u>Secondary Ion(s)</u>	
70.) 2-Chlorotoluene ^a	91	126	
71.) 1,3,5-Trimethylbenzene ^a	105	120	
72.) 4-Chlorotoluene ^a	91	126	
73.) tert-Butylbenzene ^a	119	91	134
74.) 1,2,4-Trimethylbenzene ^a	105	120	
75.) sec-Butylbenzene ^a	105	134	
76.) para-Isopropyltoluene ^a	119	134	91
77.) 1,3-Dichlorobenzene	146	111	148
78.) * 1,4-Dichlorobenzene-d ₄	152		
79.) 1,4-Dichlorobenzene	146	111	148
80.) n-Butylbenzene ^a	91	92	134
81.) 1,2-Dichlorobenzene	146	111	148
82.) 1,2-Dibromo-3-Chloropropane ^a	75	155	157
83.) 1,2,4-Trichlorobenzene ^a	180	182	145
84.) Hexachlorobutadiene ^a	225	223	227
85.) Naphthalene ^a	128	127	
86.) 1,2,3-Trichlorobenzene ^a	180	182	145

* Internal standard compound

\$ Surrogate compound

Method Modifications:

- ^a Compound is not an EPA 624 target analyte.
- ^b Compound is not an EPA 8260B target analyte.
- ^c Quantitation based on secondary ion with an abundance equivalent to or greater than that identified in method 8260. C&T's primary ion differs from the primary ion listed in the method due to presence of nearby compounds with similar ions and/or abundance of secondary ions.
- ^d Quantitation based on secondary ion with an abundance equivalent to or greater than that identified in method 624. C&T's primary ion differs from the primary ion listed in the method due to presence of nearby compounds with similar ions and/or abundance of secondary ions

Method Development:

When method development is performed to include an additional compound, the retention time of the target compound should be within 0.8-1.2 relative retention time of the associated internal standard (8260b sect. 7.3.2.2).

APPENDIX_12: TENTATIVELY IDENTIFIED COMPOUNDS (TICs)
(Library Searches)

When reporting TICs, report up to 10 peaks for each sample. If there are more than 10 peaks, then report the 10 peaks with the greatest area. Do not report any peak with an area of less than ~1/10 the area of the corresponding ISTD.

A) Find the Unknown Compounds:

Target automatically searches for unknowns and produce an unknown quantitation report, however, any unknown peaks that fall within a target analyte retention time window will not be found by Target's automatic search. Therefore, the Total Ion Chromatogram must be examined to check for missed unknowns.

- 1) In the Target Browser, right-click on the data file of the sample and select Unknown Quantitation. This is the report that Target created when it searched for unknown. Print this report for reference when searching for missed unknown.
- 2) In the Target Browser, select the correct method, then right-click on the data file of the sample and select Target Review.
- 3) Using the Target unknown quantitation report as a reference, carefully scrutinize the Total Ion Chromatogram for unknowns missed by Target.
- 4) If a missed unknown peak is found, click on the apex of the peak and perform a Library search. Go to Spectra then Search, to bring up a set of potential matches for that peak.
- 5) Go to Edit and Add Unknown. The compound with the best quality match for the peak will now appear in the Name. Click Ok to add the peak.
- 6) Continue through the Total Ion Chromatogram looking for more unknowns;

If there appears to be few unknowns in the sample (<10), make sure to add unknowns that are greater than ~1/10 the area of the corresponding ISTD.

If there appears to be many unknowns in the sample (>10), make sure that the top ten unknown peaks (by area) are identified as unknowns in Target.

- 7) When you are finished, Exit Target Review and Save your data file.
- 8) In the Target Browser, Print a new target unknown quantitation report (right-click on the data file and select Unknown Quantitation, then print it).
- 9) In the Target Browser, Open the target unknown search reports by right-clicking on the data file of the sample and select Unknown Graphics. If there are less than 10 unknowns, print out each unknown search report. If greater than 10 unknowns, then print out the unknown search report for just the top ten unknowns (by area).

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B) Identify the Unknown Compounds:

If less than 10 unknowns are found, work up all the unknown compounds. If greater than 10 unknowns are found, just work up the top ten unknowns (by area). When computer searches are performed, visual verification of the computer match is required using the following guidelines:

- 1) All ions of greater than 10% relative intensity in the library spectrum should be present in the sample.
- 2) Relative intensities of the ions must agree to within plus or minus 20% between library spectrum and sample spectrum.
- 3) Molecular ions in the library spectrum must be in the sample spectrum.
- 4) Ions present in the sample spectrum but not in the library spectrum should be checked for co-elution of other compounds and considered for background subtraction.

Note: Our MS detectors are set to begin scanning at Ion (m/z) 35. Therefore ions less than 35 should not be used in identifying the unknowns.

Verify that the system has not identified an unknown peak as a target compound, which it may do if the spectrum of the unknown is very similar to that of a target compound. If it did, review the pattern and %match for the second most-probable match and if that match is at all acceptable, report the second compound.

Interferences:

Carbon dioxide (ion m/z 44) and argon (ion m/z 40) are often found in library searches due to miniscule leaks in the analytical system. These should not be reported as TIC's.

Siloxanes are byproducts of column degradation and should not be reported as TIC's.

**APPENDIX_13: WORK UP DATA
IN TARGET & LIMS**

Data workup is accomplished by using Target/Chemstation as the data analysis software and the LIMS Review Application as the data reporting software.

A) Sequence Workup

- 1) Go to your day's Sequence in LIMS. In the top right, use the "Review" pull down menu and select your Sequence (for example: MSVOA11 08/11/06).
- 2) Login if necessary.
- 3) Check the tune and if it passes, sign off on your tune run.
- 4) Check your CCV and any spiked QC in Target/Chemstation for any necessary manual integrations. If manual integrations were needed:
 - 4.1) Make the changes and save in Target/Chemstation.
 - 4.2) Re-quant the file in Target/Chemstation and Upload to LIMS.
 - 4.3) Click the Refresh button or Click on the same sample row in the Review App. to see the corrected files.
 - 4.4) Check and sign off on your CCV and spiked QC.
- 5) Go down the list, starting with the Method Blank, by first clicking on the row of the Blank run.
- 6) Check IS and Surrogate recoveries for any failures on the LIMS Report.
- 7) Check the Total Ion Chromatogram and the Report from the Target/Chemstation capture for any high non-target or interfering peaks, or any peaks missed by Target/Chemstation due to excessively high concentration.
- 8) Go through each analyte:
 - 8.1) Check if the calculated value is above the reporting limit.
 - 8.2) Check the integration to see if it is correct. If it is not, go to Target/Chemstation and make the manual integration and save your change. Re-quant the file in Target/Chemstation and Upload to LIMS. Hit the Refresh button in the Review App. and confirm the change is in LIMS.
 - 8.3) Compare the spectra to determine if the selected analyte is indeed the target analyte.
 - 8.4) Make any changes to the flags for that analyte (ie. false positive)
- 9) Add any necessary comments for the run. If the pH>2 or there is headspace for that run, you must use the pull down comments to narrate this issue. Also provide the dilution factor if a re-run is needed.

- 10) Click Report to choose the analytes from that run. This will mark every analyte as usable (with a "u" flag), except for those that are >LR.
- 11) If necessary, click 'Re-Run' to flag the run for re-analysis. This will not remove your "u"-flags for the analytes that you wish to report.
- 12) Once your comments have been entered and your analytes are chosen, Click 'Sign' to sign off on the run.
- 13) Click on the next run or 'Save + Next' to go to the next run.
- 14) Once all samples for the sequence have been worked up, click on the Sequence in the top left corner of the Review App.
- 15) Confirm that your Batch Prep sheet has been properly scanned into LIMS. If not, re-scan the Batch Prep sheet.
- 16) Check the Sequence summary and IS summary for any errors. All pH>2 or headspace comments must be added to each relevant sample prior to submitting the sequence for review.
- 17) Make sure all pH>2 or headspace comments are shown as flags on the sequence summary.
- 18) Make any other necessary comments for the sequence. This includes any tune adjustments made to the instrument prior to the 12-hr shift or errors that occurred during the sequence run.
- 19) Click Sign to sign off on the Sequence.
- 20) Let the QC Chemist know that your sequence is ready for review.

B) Job Workup

- 1) Go to your daily Sequence in LIMS. In the top right, use the "Review" pull down menu and select the job you would like to report.
- 2) Login if necessary.
- 3) Go through each sample and check that any requested analytes are chosen ("u"ed) and each run reporting an analyte is signed. If some of the samples run were worked up by another analyst, use this opportunity to peer review those runs.
- 4) Then go through each QC run and check two things:
 - 4.1) First check that the "general version" of that QC run has been signed and second-signed. This means that the Target/Chemstation raw data has been reviewed for the QC sample.
 - 4.2) Second check that the QC passed the client-specific limits.

- 5) If both conditions are met, click Sign to sign off on the specific QC results. If the general version for a given QC run has not been signed, go into the Sequence in the Review App and review the Target/Chemstation raw data for that QC.
- 6) Once all specific versions (and general versions) of the QC have been reviewed, select the pull-down menu that says "all" and select "pkg".
- 7) Click 'Reports' then choose which Form 1's to print. Click the Refresh button at the top of the Report Manager until the report lines change colors. Retrieve the Form 1's from the printer.
- 8) Next click 'Done'. The Form 1's will now appear on the right in the Review App.
- 9) Click on Checklist and review the checklist.
- 10) Make any necessary comments for the Job in the Review App.
- 11) Click Sign to sign off on the Job.
- 12) If the Job is Level III or Level IV, then the Peer Reviewer or final reviewer will be responsible for Generating and Signing off on the Level III or Level IV part of the job.

C) Peer Review (optional)

- 1) Check the QC review queue for jobs that have not been peer reviewed
- 2) Open that job in the data review application
- 3) Login if necessary. Then you'll be in PKG mode.
- 4) Go through each sample and review the Target/Chemstation raw data that was captured.
 - Check the Total Ion Chromatogram for any peaks missed by Target due to excessive high concentrations or interferes.
 - Check the dilution factor for the sample.
 - Check that the analytes are flagged and "u"-ed properly.
 - Verify that any relevant comments have been added.
 - Sign the sample run.
- 5) After all the samples are second-signed, go through the QC and check for two signoffs for the general versions. Then review the user reports for the specific versions and sign off on them.
- 6) Next check that all sequences, ICAL, Tunes, and CCVs reported in this job have two signoffs (aka "SR").
- 7) Compare the paper Form 1's with the user reports in LIMS to check for errors.

- 8) If the job is Level II, sign off on the job.
- 9) If the job is Level III or IV, click on the Level III or Level IV row and generate a Level III or IV. You will then see a log that will indicate what else needs review before the Level III or IV is ready to report. Investigate, fix, and re-generate the Level III or IV. Again check the log. When the log only states at what time/date the Level III or Level IV was generated, sign off on the Level III or IV. Then sign off on the job.

D) ICAL (Initial Calibration) Workup

- 1) After the ICAL has run, verify that the documents for the ICAL/ICV have been captured in LIMS. All samples that have a document captured will have a D to the right of the sample type in the LIMS sequence screen.
- 2) Next, check *every* analyte in *every* ICAL level, and make any necessary manual integrations for the ICAL files using Target/Chemstation.
- 3) Once all ICAL files are checked and manual integrations are made, Re-quant the ICAL files. This will take a few minutes to requantitate all the files. Do not use "Process" (Target) or "Calculate/Generate Report" (Chemstation) or the manual integrations will be removed from the ICAL files.
- 4) Open your method in Target/Chemstation and make the necessary changes to the levels and cal types to figure out your ICAL. Check the RSD for each analyte. It may be necessary to drop the highest point of curve or use a quadratic or linear regression. Calibrations by average response or linear regression must have at least 5 points, while quadratic regression must have at least 6 points.
- 5) Upload the Target method to LIMS using the Upload to LIMS feature:
 - 5.1) Highlight any file in the directory that contains the Target method file and then choose "*Custom Functions*" then "*C&T upload to LIMS*" from the menu bar.
 - 5.2) The "*Custom Functions*" window will open.
 - 5.3) At the bottom of the window, where it says "Files of type:", click on the arrow and change to "all files".
 - 5.4) Click on the Target method file add it to the list of files to be sent to LIMS.
 - 5.5) Remove the non-method data file and click "OK".

Note: The Chemstation method need only be saved to the G: drive to update the method in LIMS.
- 6) Check the LIMS ICAL printout and the ICAL error report for any problems. This report will display calculation mismatch errors between Target/Chemstation and LIMS, and bad linear or quadratic curves that quantitate the lower point below our in-house threshold.
- 7) If there are issues displayed on the ICAL error report, investigate and correct the Target/Chemstation method.
- 8) Take some time to check any linear or quadratic curves using the "Edit" feature in LIMS.

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You might be able to create a better curve fit, by dropping high points or change the curve type. The “Edit” feature is to be used as a tool to help determine the best curve fit for a given analyte. Therefore, you *must* apply any and all changes to the Target/Chemstation method. In addition, a new initial calibration *must* be created in LIMS (as stated in step 5 above). Check the report for the results of the changes made.

Note: To send datafiles to LIMS from Chemsation, choose “Quantiate” from the top menu. Choose “Generate Report”. Make sure the style is set to “detailed” and the printer box is checked.

- 9) Again check for any errors. If there are, Repeat step 7 above until the ICAL error report is free of problems.
- 10) Now that you're Target//Chemstation /LIMS method is set, select the updated Target /Chemstation method then process the ICV files. Check the ICV run for any necessary manual integrations. Re-quant the ICV, Upload it to LIMS, and review the report for any failures.
- 11) Process the Calib IB with the updated Target/Chemstation method, and Upload to LIMS. Examine the report and make sure any analytes hits are below the low point of the calibration and not interfering with the initial calibration.
- 12) Sign off on all data files, sequence, and the initial calibration. Send for review.

APPENDIX_14 RESEARCHING HISTORICAL DATA

Searching historical data can be helpful in determining what dilution to prepare a sample at. Many clients have long-term projects, often going back for years, that use similar client identification numbers for the samples at a given site. Since we've analyzed the samples in the past, we should have a database of results for that sample in our LIMS system.

- 1) Start at the "C&T Main Page". Next click on "Project Management" then "Sample Login".
- 2) To Login, you must enter you user initials and password. This is a protected form in LIMS and requires permission to access it. See the Group Leader or Department Manager to obtain the proper permissions.
- 3) Once the "Sample Login" screen is loaded, go to "Query" then "Enter".
- 4) Look at the Job Sheet and examine:
 - i. The Projectnum of the job
 - ii. The Site of the Job
 - iii. The Client ID of each sample in the job
- 5) Use a combination of the three values above (Projectnum, Site, Client ID) for the search. Enter the values into the form, then go to "Query" then "Execute".
- 6) LIMS will display the first page of samples that match the search fields that were entered. Use the down arrow to scroll through the matches. Take note of the Lab ID's when scrolling through the matches. Use these (at least 3 matches) Lab ID's to search in LIMS for those older sample runs.

Note: If LIMS did not find a match, it will display the message: "FRM-40301: Query caused no records to be retrieved. Re-Enter"

It may be necessary to use a different combination of Projectnum, Site, and Client ID to yield any useful results. In addition, the percent sign "%" character can be used in any field search as a wildcard. For example, entering "SAN%" in the site field would yield matches for any word or phase that started with SAN. Some example results could be SAN FRANCISCO, SANTA MONICA, SANTIAGO, SANGER, SANTEE, etc. The "%" wildcard is very useful considering that client may spell the same site two different ways.

- 7) Compare multiple results for each sample. If the historical data appears to be consistent, write the dilution factor next to the Lab ID on the Job Sheet. If there are inconsistent historical results for the sample, then the sample should be screened prior to analysis.

**APPENDIX_15: METHOD DETECTION LIMIT (MDL) STUDY
Flagging & Approval Rules**

After the MDL samples have been run and the data has been worked up, create an MDL in LIMS by checking the box, on the sequence log, next to the MDL runs you want to use, then click the ">" symbol next to "Tasks" at the bottom of the screen. Click the "Create MDL" box and then review the study against the following rules:

Flag	Definition	Useability
u	marked for use	Best case is when no other flags are present
G	MDL < 1/5 avg measured concentration	Ok to use
E	MDL < 1/10 spiked concentration	Ok if spiked at or below the reporting limit

Any data flagged with the following should not be used:

A	MDL > reporting limit
C	MDL > 1/3 reporting limit
F	MDL > spiked concentration
H	MDL > avg measured concentration
N	ND in at least one run

APPENDIX_16: EPA 624: PURGEABLE ORGANICS in WASTEWATER

The following criteria and discussion apply to any samples submitted for the EPA 624 analysis:

Tuning (BFB):

The 50ng BFB acceptance criteria listed in EPA 624 are the same as the EPA 8260 criteria and can be found in [Appendix 8](#) above.

Initial Calibration:

Method 624 only requires 3 points and average response can be used so long as the RSD is $\leq 35\%$; a regression curve may be used if the RSD exceeds 35% or whenever desired. Although 624 only requires 3 calibration points, the same general calibration criteria must be followed (ie: intermediate levels may not be dropped). Any calibrations to be used for both 8260 and 624 must meet the SW-846 requirements described in Sections 10.a – 10.e of [Appendix 9](#) above.

Calibration Verification (ICV & CCV)

Method 624 does not discuss the use of an ICV (Initial Calibration Verification standard) to validate the initial calibration curve, however C&T's NELAC accreditation requires it; the ICV must be analyzed and approved following the procedure described in [Appendix 8](#) above.

Method 624 also only requires that a CCV (Continuing Calibration Verification) standard be analyzed once daily, however C&T policy is to follow the SW-846 guidance and analyze the CCV at the beginning of each 12-hour tune-shift.

EPA 624 does not discuss minimum response requirements or differentiate between various types of analytes. The recoveries must meet those listed in Table 5 of the method, however the criteria listed in Section 1 of [Appendix 8](#) above are tighter than those listed in the method and should be used for routine analysis.

Batch QC:

EPA 624 defines the LCS and MS recovery limits in Table 5 of the method, however C&T statistically generated limits are consistently and considerably tighter than those identified in this table; C&T will use the tighter, statistically generated limits.

Instrument Conditions:

Curtis & Tompkins uses current technology, namely capillary columns in place of the packed columns described in the method, so instrument conditions are somewhat different than those listed in the method. See [Appendix 6](#) and instrument maintenance logs for instrument parameters.

Quantitation:

The ions used for quantitation are listed in [Appendix 11](#), including identification of those whose quantitation is based on a secondary ion.

Attachment 3
Laboratory Information
(DoD ELAP Accreditation Certificate and In-House Control Limits)



The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

CURTIS & TOMPKINS, LLC

Berkeley, CA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 10th day of January 2012.



A handwritten signature in black ink, reading "Peter Meyer", is written over a horizontal line.

President & CEO
For the Accreditation Council
Certificate Number 2943.01
Valid to February 28, 2014

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

CURTIS & TOMPKINS, LLC.¹
 2323 5th Street
 Berkeley, CA, 94710
 Carolyn Brizzolara Phone: (510) 204 2237
 carolyn.brizzolara@ctberk.com

ENVIRONMENTAL

Valid To: February 28, 2014

Certificate Number: 2943.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Misc.- Electronic Probes (pH, O₂), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), IR Spectrometry, Titrimetry, Total Organic Carbon

<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
<u>Metals</u>						
Aluminum	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Antimony	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Arsenic	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Barium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Beryllium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
Cadmium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Calcium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Chromium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Cobalt	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Copper	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Iron	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Lead	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Magnesium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Manganese	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Mercury	-----	-----	EPA 7470A	EPA 7470A	EPA 7470A / 7471A / 7471B	EPA 7470A / 7471A / 7471B
Molybdenum	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Nickel	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Potassium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Selenium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Silver	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Sodium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B
Thallium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 6020A	EPA 3050B

Peter M. Myers

Parameter/Analyte	Potable Water	Potable Water Prep Methods	Nonpotable Water	Nonpotable Water Prep Methods	Solid Hazardous Waste	Solid Hazardous Waste Prep Methods
Vanadium	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 / 6020A	EPA 3050B
Zinc	-----	-----	EPA 6010B / 6010C / 6020 / 6020A	EPA 200.8 / 3010A	EPA 6010B / 6010C / 6020 / 6020A	EPA 3050B
<u>Nutrients</u>						
Ammonia (as N)	-----	-----	SM 4500NH3-D	SM 4500NH3-D	SM 4500NH3-D	SM 4500NH3-D
Kjeldahl Nitrogen	-----	-----	SM 4500NH3-C	SM 4500NH3-C	SM 4500NH3-C	SM 4500NH3-C
Nitrate (as N)	-----	-----	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056
Nitrite (as N)	-----	-----	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056
Perchlorate	-----	-----	EPA 314.0	EPA 314.0	-----	-----
Total phosphorus	-----	-----	SM 4500P-E	SM 4500P-E	-----	-----
<u>Demands</u>						
Biochemical Oxygen Demand	-----	-----	SM 5210B	SM 5210B	-----	-----
Chemical Oxygen Demand	-----	-----	SM 5220D	SM 5220D	-----	-----
Total Organic Carbon	-----	-----	SM 5310C	SM 5310C	-----	-----
<u>Wet Chemistry</u>						
Alkalinity	SM 2320B	SM 2320B	SM 2320B	SM 2320B	-----	-----
Bromide	-----	-----	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056
Chloride	-----	-----	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056
Cyanide	-----	-----	SM 4500 CN-E / EPA 9010B / 9014	SM 4500 CN-E / EPA 9010B / 9014	SM 4500 CN-E / EPA 9010B / 9014	SM 4500 CN-E / EPA 9010B / 9014
Amenable Cyanide	-----	-----	SM 4500 CN-E / EPA 9010B / 9014	SM 4500 CN-E / EPA 9010B / 9014	EPA 9010B / 9014	EPA 9010B / 9014
Ferrous Iron	-----	-----	SM 3500Fe-B	SM 3500Fe-B	-----	-----
Flash Point	-----	-----	EPA 1010	EPA 1010	-----	-----
Fluoride	-----	-----	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056
Hexavalent Chromium	-----	-----	EPA 7196A / 7199 / SM 3500Cr-B,C	EPA 7196A / 7199 / SM 3500Cr-B,C	EPA 3060 / 7196A	EPA 3060 / 7196A
pH	-----	-----	EPA 9040B / SM 4500-H ⁺ B	EPA 9040B / SM 4500-H ⁺ B	EPA 9045C	EPA 9045C
Specific Conductance	-----	-----	SM 2510 B	SM 2510 B	-----	-----

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
Sulfate	-----	-----	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056	EPA 300.0 / 9056
Sulfide	-----	-----	SM 4500S2-D	SM 4500S2-D	SM 9034	SM 9030B
Total Dissolved Solids	-----	-----	SM 2540C	SM 254C	-----	-----
Total Suspended Solids	-----	-----	SM 2540D	SM 2540 D	-----	-----
<u>Purgeable Organics (volatiles)</u>						
Gas Range Organics (GRO)	-----	-----	EPA 8015B / 8015D	EPA 5030B / 5030C	EPA 8015B / 8015D	EPA 5030B / 5030C / 5035 / 5035A
Acetone	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Benzene	-----	-----	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C / 5035 / 5035A
Bromobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Bromochloromethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Bromodichloromethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Bromoform	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Bromomethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
2-Butanone	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Tert-Butyl Alcohol (TBA)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
n-Butylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
sec-Butylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
tert-Butylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Carbon Disulfide	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
Carbon Tetrachloride	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Chlorobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Chloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Chloroform	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Chloromethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
2-Chlorotoluene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
4-Chlorotoluene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Dibromochloromethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2-Dibromo-3-chloropropane (DBCP)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Dibromomethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2 Dibromomethane (EDB)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2-Dichlorobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,3-Dichlorobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,4-Dichlorobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Dichlorodifluoromethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1-Dichloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2-Dichloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
1,1-Dichloroethene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
cis-1,2-Dichloroethene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
trans-1,2-Dichloroethene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2-Dichloropropane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,3-Dichloropropane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
2,2-Dichloropropane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1-Dichloropropene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
cis-1,3-Dichloropropene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
trans-1,3-Dichloropropene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Ethyl Benzene	-----	-----	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C / 5035 / 5035A
Ethyl tert-Butyl Ether (ETBE)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
2-Hexanone	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Hexachlorobutadiene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Isopropylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Isopropyl Ether (DIPE)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Para-Isopropyltoluene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
Methylene Chloride	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
4-Methyl-2-pentanone	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Methyl tert-amyl Ether (TAME)	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Methyl tert-butyl ether (MTBE)	-----	-----	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C / 5035 / 5035A
Naphthalene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
n-Propylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Styrene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1,1,2-Tetrachloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1,1,2-Tetrachloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Tetrachloroethene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Toluene	-----	-----	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C / 5035 / 5035A
1,2,3-Trichlorobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2,4-Trichlorobenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1,1-Trichloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,1,2-Trichloroethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Trichloroethene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Trichlorofluoromethane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
1,2,3-Trichloropropane	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,2,4-Trimethylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
1,3,5-Trimethylbenzene	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Vinyl acetate	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
Vinyl chloride	-----	-----	EPA 8260B / 8260C	EPA 5030B / 5030C	EPA 8260B / 8260C	EPA 5030B / 5030C / 5035 / 5035A
m,p-Xylene	-----	-----	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C / 5035 / 5035A
o-Xylene	-----	-----	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C	EPA 8260B / 8260C / 8021B	EPA 5030B / 5030C / 5035 / 5035A
<u>Extractable Organics (semivolatiles)</u>						
DRO	-----	-----	EPA 8015B / 8015D	EPA 3520C	EPA 8015B / 8015C / 8015D	EPA 3550B / 3550C / 3546
Acenaphthene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Acenaphthylene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Anthracene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Benzoic Acid	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270 C / 8270D	EPA 3550B / 3550C
Benzo (a) Anthracene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C

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Benzo (b) Fluoranthene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Benzo (k) Fluoranthene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Benzo (ghi) Fluoranthene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Benzo (a) Pyrene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270 C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Benzyl Alcohol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Bis (2-chloroethoxy) Methane	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Bis (2-chloroethyl) Ether	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Bis (2-chloroisopropyl) Ether	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Bis (2-ethylhexyl) Phthalate	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Bromophenyl-Phenylether	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Butyl Benzyl Phthalate	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Chloroaniline	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Chloro-3-methylphenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2-Chloronaphthalene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
2-Chlorophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Chlorophenyl Phenyl Ether	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Chrysene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Dibenzo (a,h) Anthracene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Dibenzofuran	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
1,2-Dichlorobenzene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
1,3-Dichlorobenzene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
1,4-Dichlorobenzene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
3,3'-Dichlorobenzidine	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,4-Dichlorophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Diethyl Phthalate	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,4-Dimethylphenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Dimethyl Phthalate	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Di-n-butyl Phthalate	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Di-n-octyl Phthalate	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C

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Parameter/Analyte	Potable Water	Potable Water Prep Methods	Nonpotable Water	Nonpotable Water Prep Methods	Solid Hazardous Waste	Solid Hazardous Waste Prep Methods
4,6-Dinitro-2-methylphenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,4-Dinitrophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,4-Dinitrotoluene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,6-Dinitrotoluene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
1,4 - Dioxane			EPA 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
1,2-Diphenylhydrazine reported as Azobenzene due to breakdown	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Fluoroanthene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 8270C / 8270D 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Fluorene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Hexachlorobenzene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Hexachlorobutadiene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Hexachloro cyclopentadiene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Hexachloroethane	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Indeno (1,2,3-cd) pyrene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
Isophorone	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
1-Methylnaphthalene	-----	-----	EPA 8270C-SIM / 8270D-DIM	EPA 3520C	EPA 8270C-SIM / 8270D-DIM	EPA 3550B / 3550C

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
2-Methylnaphthalene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
2-Methylphenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Methylphenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Naphthalene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
2-Nitroaniline	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
3-Nitroaniline	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Nitroaniline	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Nitrobenzene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2-Nitrophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
4-Nitrophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
N-Nitrosodi-n-propylamine	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
N-Nitrosodimethylamine	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
N-Nitrosodiphenylamine	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Pentachlorophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Phenanthrene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C

Peter M. Meyer

<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
Phenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
Pyrene	-----	-----	EPA 8310 / 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3520C	EPA 8310 8270C / 8270D / 8270C-SIM / 8270D-SIM	EPA 3550B / 3550C
1,2,4-Trichlorobenzene	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,4,5-Trichlorophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
2,4,6-Trichlorophenol	-----	-----	EPA 8270C / 8270D	EPA 3520C	EPA 8270C / 8270D	EPA 3550B / 3550C
<u>Pesticides/PCBs</u>						
Aldrin	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
alpha-BHC	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
beta-BHC	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
delta-BHC	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
gamma-BHC	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Chlordane (technical)	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
alpha-Chlordane	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
gamma-Chlordane	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
4,4'-DDD	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
4,4'-DDE	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
4,4',-DDT	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Dieldrin	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Endosulfan I	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Endosulfan II	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Endonsulfan Sulfate	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Endrin	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C

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<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
Endrin Aldehyde	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Endrin Ketone	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Heptachlor	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Heptachlor Epoxide	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
Methoxychlor	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
PCB-1016 (Arochlor)	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
PCB-1221	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
PCB-1232	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
PCB-1242	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
PCB-1248	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
PCB-1254	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
PCB-1260	-----	-----	EPA 8082 / 8082A	EPA 3520C	EPA 8082 / 8082A	EPA 3550B / 3550C
Toxaphene	-----	-----	EPA 8081A / 8081B	EPA 3520C	EPA 8081A / 8081B	EPA 3550B / 3550C
<u>Nitroaromatics & Nitramines</u>						
2-Amino-4,6-dinitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
4-Amino-2,6-dinitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
1,3-Dinitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
2,4-Dinitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
2,6-Dinitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A

Peter M. Meyer

<u>Parameter/Analyte</u>	<u>Potable Water</u>	<u>Potable Water Prep Methods</u>	<u>Nonpotable Water</u>	<u>Nonpotable Water Prep Methods</u>	<u>Solid Hazardous Waste</u>	<u>Solid Hazardous Waste Prep Methods</u>
HMX	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
Nitrobenzene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
2-Nitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
3-Nitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
4-Nitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
RDX	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
Tetryl	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
1,3,5-Trinitrobenzene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
2,4,6-Trinitrotoluene	-----	-----	EPA 8330 / 8330A	EPA 3535	EPA 8330 / 8330A / 8330A Modified	EPA 8330 / 8330A
<u>Hazardous Waste Characteristics</u>						
Synthetic Precipitation Leaching Procedure (SPLP)	-----	-----	-----	-----	EPA 1312	EPA1312
Toxicity Characteristic Leaching Procedure (TCLP)	-----	-----	-----	-----	EPA 1311	EPA 1311
<u>Air</u>						
Carbon Dioxide	-----	-----	RSK-175	RSK-175	-----	-----
Ethane	-----	-----	RSK-175	RSK-175	-----	-----
Ethene	-----	-----	RSK-175	RSK-175	-----	-----
Methane	-----	-----	RSK-175	RSK-175	-----	-----

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Peter Wagner

Parameter/Analyte	Potable Water	Potable Water Prep Methods	Nonpotable Water	Nonpotable Water Prep Methods	Solid Hazardous Waste	Solid Hazardous Waste Prep Methods
Acetylene	-----	-----	RSK-175	RSK-175	-----	-----

Parameter/Analyte	Air Analysis
1,1,1-Trichloroethane	TO-15
1,1,2,2-Tetrachloroethane	TO-15
1,1,2-Trichloroethane	TO-15
1,1-Dichloroethane	TO-15
1,1-Dichloroethene	TO-15
1,2,4-Trichlorobenzene	TO-15
1,2,4-Trimethylbenzene	TO-15
1,2-Dibromoethane	TO-15
1,2-Dichlorobenzene	TO-15
1,2-Dichloroethane	TO-15
1,2-Dichloropropane	TO-15
1,3,5-Trimethylbenzene	TO-15
1,3-Butadiene	TO-15
1,3-Dichlorobenzene	TO-15
1,4-Dichlorobenzene	TO-15
2-Butanone	TO-15
2-Hexanone	TO-15
4-Ethyltoluene	TO-15
4-Methyl-2-Pentanone	TO-15
Acetone	TO-15
Acrolein	TO-15
Benzene	TO-15
Benzyl chloride	TO-15
Bromodichloromethane	TO-15
Bromoform	TO-15
Bromomethane	TO-15
Carbon Disulfide	TO-15
Carbon Tetrachloride	TO-15
Chlorobenzene	TO-15
Chloroethane	TO-15
Chloroform	TO-15
Chloromethane	TO-15
Cyclohexane	TO-15
Dibromochloromethane	TO-15
Ethyl Acetate	TO-15
Ethylbenzene	TO-15
Freon 113	TO-15
Freon 114	TO-15
Freon 12	TO-15
Hexachlorobutadiene	TO-15
MTBE	TO-15
Methylene Chloride	TO-15
Napthalene	TO-15
Propylene	TO-15
Styrene	TO-15

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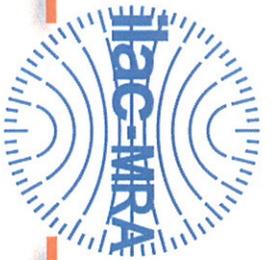
<u>Parameter/Analyte</u>	<u>Air Analysis</u>
Tetrachloroethene	TO-15
Tetrahydrofuran	TO-15
Toluene	TO-15
Trichloroethene	TO-15
Trichlorofluoromethane	TO-15
Vinyl Acetate	TO-15
Vinyl Chloride	TO-15
cis-1,2-Dichloroethene	TO-15
cis-1,3-Dichloropropene	TO-15
m,p-Xylenes	TO-15
n-Heptane	TO-15
n-Hexane	TO-15
o-Xylene	TO-15
trans-1,2-Dichloroethene	TO-15
trans-1,3-Dichloropropene	TO-15

1. This accreditation covers testing performed at the main laboratory listed above and the following satellite laboratory listed below for the following tests:

201A & 201B Fischer Ave
 Hunters Point Naval Ship Yard
 San Francisco, CA 94124

<u>Gamma Spectroscopy</u> <u>Parameter/Analyte</u>	<u>Solid/Wipe Analysis</u>
Actinium – 228	Modified EPA Method 901.1
Americium – 241	Modified EPA Method 901.1
Bismuth – 212	Modified EPA Method 901.1
Bismuth – 214	Modified EPA Method 901.1
Cesium - 137	Modified EPA Method 901.1
Cobalt – 60	Modified EPA Method 901.1
Europium – 152	Modified EPA Method 901.1
Europium – 154	Modified EPA Method 901.1
Lead - 210	Modified EPA Method 901.1
Lead – 212	Modified EPA Method 901.1
Lead - 214	Modified EPA Method 901.1
Potassium – 40	Modified EPA Method 901.1
Protactinium – 234M	Modified EPA Method 901.1
Radium – 226	Modified EPA Method 901.1
Thallium – 208	Modified EPA Method 901.1
Thorium - 232	Modified EPA Method 901.1
Thorium - 234	Modified EPA Method 901.1
Uranium - 235	Modified EPA Method 901.1
<u>Gross Alpha Beta Spectroscopy</u> <u>Gas Proportional Counter</u>	
Alpha & Beta Radiation	Modified EPA Method 9310





The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

CURTIS & TOMPKINS, LLC

Berkeley, CA

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the current DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 10th day of January 2012.

President & CEO

For the Accreditation Council

Certificate Number 2943.01

Valid to February 28, 2014



For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

EPA 624, EPA 8260B, EPA 8260C QC Limits

C&T In-House Limits for
Mar 27, 2012 - Sep 26, 2012

Matrix	Analyte	LCS/LCSD		MS/MSD	
		Recovery	RPD	Recovery	RPD
Water	Freon 12	46	- 128 22	57	- 120 21
	tert-Butyl Alcohol (TBA)	47	- 136 28	65	- 147 29
	Chloromethane	46	- 134 23	58	- 120 20
	Isopropyl Ether (DIPE)	54	- 136 20	71	- 121 20
	Vinyl Chloride	62	- 148 21	72	- 134 20
	Bromomethane	35	- 159 26	42	- 135 42
	Ethyl tert-Butyl Ether (ETBE)	57	- 133 20	75	- 122 20
	Chloroethane	60	- 143 22	70	- 131 25
	Methyl tert-Amyl Ether (TAME)	65	- 120 20	78	- 120 20
	Trichlorofluoromethane	65	- 144 20	77	- 134 21
	Acetone	47	- 159 28	42	- 120 25
	Freon 113	66	- 138 20	74	- 127 20
	1,1-Dichloroethene	66	- 131 20	74	- 123 20
	Methylene Chloride	69	- 132 22	75	- 123 20
	Carbon Disulfide	59	- 124 20	65	- 120 20
	MTBE	61	- 121 20	74	- 120 20
	trans-1,2-Dichloroethene	72	- 130 20	77	- 125 20
	Vinyl Acetate	49	- 179 22	67	- 154 20
	1,1-Dichloroethane	68	- 135 20	77	- 127 20
	2-Butanone	49	- 143 22	59	- 123 20
	cis-1,2-Dichloroethene	73	- 130 20	78	- 126 20
	2,2-Dichloropropane	75	- 154 20	75	- 132 20
	Chloroform	73	- 129 20	79	- 123 20
	Bromochloromethane	76	- 130 20	80	- 125 20
	1,1,1-Trichloroethane	76	- 138 20	80	- 132 20
	1,1-Dichloropropene	79	- 127 20	80	- 120 20
	Carbon Tetrachloride	76	- 142 20	80	- 133 20
	1,2-Dichloroethane	70	- 136 20	80	- 125 20
	Benzene	80	- 121 20	80	- 120 20
	Trichloroethene	79	- 120 20	68	- 122 20
	1,2-Dichloropropane	73	- 123 20	80	- 120 20
	Bromodichloromethane	79	- 126 20	80	- 120 20
	Dibromomethane	80	- 120 20	80	- 120 20
	4-Methyl-2-Pentanone	52	- 123 20	70	- 125 20
	cis-1,3-Dichloropropene	80	- 126 20	80	- 120 20
	Toluene	80	- 120 20	80	- 120 20
	trans-1,3-Dichloropropene	70	- 120 20	78	- 120 20
	1,1,2-Trichloroethane	80	- 120 20	80	- 120 20
	2-Hexanone	49	- 132 22	60	- 122 20
	1,3-Dichloropropane	80	- 120 20	80	- 120 20
	Tetrachloroethene	79	- 127 20	80	- 120 20
	Dibromochloromethane	80	- 121 20	80	- 120 20
	1,2-Dibromoethane	80	- 120 20	80	- 120 20
	Chlorobenzene	80	- 120 20	80	- 120 20
	1,1,1,2-Tetrachloroethane	80	- 120 20	80	- 120 20
	Ethylbenzene	80	- 120 20	80	- 120 20
	m,p-Xylenes	80	- 121 20	80	- 120 20
	o-Xylene	80	- 121 20	80	- 120 20

EPA 624, EPA 8260B, EPA 8260C QC Limits

C&T In-House Limits for
Mar 27, 2012 - Sep 26, 2012

Matrix	Analyte	LCS/LCSD	MS/MSD
		Recovery RPD	Recovery RPD
	Styrene	80 - 120 20	77 - 120 20
	Bromoform	74 - 131 20	80 - 124 20
	Isopropylbenzene	65 - 120 20	71 - 120 20
	1,1,2,2-Tetrachloroethane	71 - 130 20	80 - 131 20
	1,2,3-Trichloropropane	69 - 121 20	80 - 121 20
	Propylbenzene	76 - 126 20	80 - 120 20
	Bromobenzene	80 - 120 20	80 - 120 20
	1,3,5-Trimethylbenzene	80 - 127 20	80 - 120 20
	2-Chlorotoluene	80 - 125 20	80 - 120 20
	4-Chlorotoluene	77 - 120 20	80 - 120 20
	tert-Butylbenzene	77 - 126 20	80 - 120 20
	1,2,4-Trimethylbenzene	80 - 125 20	80 - 120 20
	sec-Butylbenzene	76 - 132 20	80 - 120 20
	para-Isopropyl Toluene	73 - 124 20	77 - 120 20
	1,3-Dichlorobenzene	80 - 120 20	80 - 120 20
	1,4-Dichlorobenzene	80 - 120 20	80 - 120 20
	n-Butylbenzene	75 - 136 20	80 - 122 20
	1,2-Dichlorobenzene	80 - 120 20	80 - 120 20
	1,2-Dibromo-3-Chloropropane	59 - 121 20	74 - 125 20
	1,2,4-Trichlorobenzene	69 - 127 20	78 - 120 20
	Hexachlorobutadiene	70 - 149 22	77 - 128 20
	Naphthalene	62 - 132 20	78 - 129 20
	1,2,3-Trichlorobenzene	71 - 133 20	80 - 123 20
	Dibromofluoromethane	80 - 125	80 - 125
	1,2-Dichloroethane-d4	69 - 145	69 - 145
	Toluene-d8	80 - 120	80 - 120
	Bromofluorobenzene	80 - 120	80 - 120

EPA 624, EPA 8260B, EPA 8260C QC Limits

C&T In-House Limits for
Dec 30, 2011 - Jun 29, 2012

Matrix	Analyte	LCS/LCSD		MS/MSD	
		Recovery	RPD	Recovery	RPD
Soil	Freon 12	49	- 120 23	39	- 120 48
	tert-Butyl Alcohol (TBA)	46	- 135 36	44	- 128 39
	Chloromethane	57	- 120 24	44	- 120 43
	Isopropyl Ether (DIPE)	59	- 120 21	50	- 120 32
	Vinyl Chloride	65	- 129 25	52	- 125 47
	Bromomethane	66	- 149 25	51	- 127 41
	Ethyl tert-Butyl Ether (ETBE)	64	- 120 20	55	- 120 32
	Chloroethane	65	- 132 23	50	- 125 47
	Methyl tert-Amyl Ether (TAME)	68	- 120 20	55	- 120 34
	Trichlorofluoromethane	64	- 133 21	51	- 129 41
	Acetone	61	- 172 32	37	- 186 44
	Freon 113	68	- 126 20	50	- 127 37
	1,1-Dichloroethene	71	- 125 20	55	- 127 38
	Methylene Chloride	65	- 139 24	54	- 123 41
	Carbon Disulfide	60	- 120 22	42	- 120 42
	MTBE	62	- 120 22	51	- 120 32
	trans-1,2-Dichloroethene	71	- 126 22	55	- 125 38
	Vinyl Acetate	38	- 146 31	1	- 120 94
	1,1-Dichloroethane	69	- 125 20	55	- 123 36
	2-Butanone	54	- 141 28	37	- 128 41
	cis-1,2-Dichloroethene	76	- 125 20	59	- 124 34
	2,2-Dichloropropane	73	- 133 20	56	- 131 43
	Chloroform	73	- 124 20	56	- 122 34
	Bromochloromethane	80	- 125 20	61	- 124 32
	1,1,1-Trichloroethane	75	- 130 22	57	- 131 33
	1,1-Dichloropropene	74	- 123 20	52	- 125 37
	Carbon Tetrachloride	75	- 132 20	54	- 135 38
	1,2-Dichloroethane	74	- 126 20	55	- 121 33
	Benzene	78	- 125 20	58	- 122 37
	Trichloroethene	77	- 121 20	45	- 142 41
	1,2-Dichloropropane	74	- 120 20	57	- 120 37
	Bromodichloromethane	77	- 121 20	54	- 120 36
	Dibromomethane	78	- 120 20	57	- 120 33
	4-Methyl-2-Pentanone	60	- 120 23	42	- 120 38
	cis-1,3-Dichloropropene	77	- 120 20	49	- 120 38
	Toluene	79	- 120 20	54	- 120 35
	trans-1,3-Dichloropropene	67	- 120 20	42	- 120 40
	1,1,2-Trichloroethane	75	- 120 20	51	- 120 38
	2-Hexanone	57	- 121 25	34	- 120 47
	1,3-Dichloropropane	77	- 120 20	55	- 120 37
	Tetrachloroethene	79	- 122 20	49	- 122 42
	Dibromochloromethane	77	- 120 20	52	- 120 32
	1,2-Dibromoethane	77	- 120 20	52	- 120 35
Chlorobenzene	80	- 120 20	49	- 120 38	
1,1,1,2-Tetrachloroethane	79	- 120 20	53	- 120 34	
Ethylbenzene	80	- 120 20	47	- 120 40	
m,p-Xylenes	80	- 120 20	47	- 120 40	
o-Xylene	79	- 120 20	47	- 120 40	

EPA 624, EPA 8260B, EPA 8260C QC Limits

C&T In-House Limits for
Dec 30, 2011 - Jun 29, 2012

Matrix	Analyte	LCS/LCSD		MS/MSD	
		Recovery	RPD	Recovery	RPD
	Styrene	80	120 20	43	120 44
	Bromoform	73	120 20	47	120 35
	Isopropylbenzene	64	120 20	36	120 48
	1,1,2,2-Tetrachloroethane	70	124 20	33	125 45
	1,2,3-Trichloropropane	68	120 20	46	120 35
	Propylbenzene	76	120 20	37	120 50
	Bromobenzene	80	120 20	45	120 39
	1,3,5-Trimethylbenzene	78	124 20	40	120 49
	2-Chlorotoluene	78	124 20	41	120 45
	4-Chlorotoluene	75	120 20	38	120 43
	tert-Butylbenzene	75	120 23	38	121 52
	1,2,4-Trimethylbenzene	76	120 20	36	120 52
	sec-Butylbenzene	76	121 20	31	122 56
	para-Isopropyl Toluene	71	120 22	30	120 55
	1,3-Dichlorobenzene	80	120 20	34	120 47
	1,4-Dichlorobenzene	80	120 20	35	120 46
	n-Butylbenzene	74	123 20	25	120 62
	1,2-Dichlorobenzene	80	120 20	35	120 44
	1,2-Dibromo-3-Chloropropane	61	120 23	34	120 37
	1,2,4-Trichlorobenzene	71	121 20	15	120 59
	Hexachlorobutadiene	73	128 20	14	120 65
	Naphthalene	67	120 21	20	120 55
	1,2,3-Trichlorobenzene	75	122 20	15	120 59
	Dibromofluoromethane	74	133	74	133
	1,2-Dichloroethane-d4	74	136	74	136
	Toluene-d8	80	120	80	120
	Bromofluorobenzene	77	130	77	130
	Trifluorotoluene	60	135	60	135

Appendix B
Construction Quality Control Plan

FINAL
CONSTRUCTION QUALITY CONTROL PLAN
Supplemental Investigation
Installation Restoration Site 28
Former Naval Air Station Moffett Field
Moffett Field, California

Contract Number: N62473-10-D-4009
Contract Task Order: 0046

Document Control Number: SHAW-4009-0046-0776.R1

June 2012

Submitted to :



Base Realignment and Closure
Program Management Office West Naval Facilities Engineering Command
1455 Frazee Road, Suite 900
San Diego, California 92108

Submitted by:



4005 Port Chicago Highway
Concord, California 94520-1120

FINAL
CONSTRUCTION QUALITY CONTROL PLAN
Supplemental Investigation
Installation Restoration Site 28
Former Naval Air Station Moffett Field
Moffett Field, California

Contract Number: N62473-10-D-4009
Contract Task Order: 0046

Document Control Number: SHAW-4009-0046-0776.R1

June 2012

Approved by: 
Neil Hey, California PG No. 8006
Project Manager

Date: June 27, 2012

Approved by: 
Steve Massey
Quality Control Manager

Date: June 27, 2012

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Attachment 2	Project Quality Control Duties and Responsibilities
Attachment 3	Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate
Attachment 4	Alternate Project Quality Control Manager Letter of Designation, Resume, and Construction Quality Management Training Certificate
Attachment 5	Outside Organizations
Attachment 6	Submittal Register
Attachment 7	Testing Plan and Log
Attachment 8	Definable Features of Work Matrix

Acronyms and Abbreviations

CTO	Contract Task Order
QCD	quality control directive
Shaw	Shaw Environmental & Infrastructure, Inc.

1.0 Introduction

Shaw Environmental & Infrastructure, Inc. (Shaw) has prepared this Construction Quality Control Plan, under Contract Task Order (CTO) 0046, to describe the quality control actions that will be implemented during the Supplemental Investigation at Installation Restoration Site 28, former Naval Air Station Moffett Field, California. This Construction Quality Control Plan will be used in conjunction with the *Construction Quality Management Plan, Radiological Environmental Multiple Award Contract (RADMAC) for Environmental Remediation Services of Radiological Contaminants at Various Locations within the Naval Facilities Engineering Command, Southwest and Atlantic Areas of Responsibility and Other Department of Defense Locations Nationwide* (Shaw, 2010a), which includes quality control directives (QCDs); *E&I Standard Operating Procedures* (Shaw, 2012); and the *Quality Control Plan, NAVFAC Environmental Services* (Naval Facilities Engineering Command Environmental Services, 2010). Attachment 1 depicts Shaw's project organization for this CTO. Attachments 2 through 8 are documents from QCDs tailored to this CTO, which will help achieve the statement of objectives and performance work statements.

2.0 Procedures

The project team, including subcontractors, will use procedures in this section to ensure quality and achieve statement of objectives and performance work statements.

2.1 Quality Control Directives

The following QCDs apply to this CTO, except as noted:

- QCD 1.0: Project Quality Control Personnel Duties, Qualifications, and Authority
- QCD 2.0: Project Quality Control Plans
- QCD 3.0: Design Review
- QCD 4.0: Coordination and Mutual Understanding Meeting
- QCD 5.0: Project Quality Control Meetings
- QCD 6.0: Submittals
- QCD 7.0: Documentation
- QCD 8.0: Quality Control Certifications
- QCD 9.0: Three Phases of Control
- QCD 10.0: Completion Inspections
- QCD 11.0: Testing
- QCD 12.0 Corrective Action Requests and Non-Compliance

2.2 Shaw Environmental & Infrastructure, Inc. Quality Procedures

The following Shaw quality procedures apply to this CTO:

- EI-Q005: Inspection
- EI-Q006: Surveillance
- EI-Q007: Nonconformance Reporting
- EI-Q008: Corrective Action
- EI-Q009: Quality Audits
- EI-Q010: Auditor and Lead Auditor Qualification Program
- EI-Q011: Verification of Figures, Drawings, Tables, and Logs

- EI-Q012: Verification of Calculations, Spreadsheets, and Databases
- EI-Q013: Analytical Laboratory Oversight and Performance Monitoring
- Q-001: Quality Organization
- Q-002: Stop Work Order
- Q-003: Project Quality Plan
- Q-004: Receipt Inspection

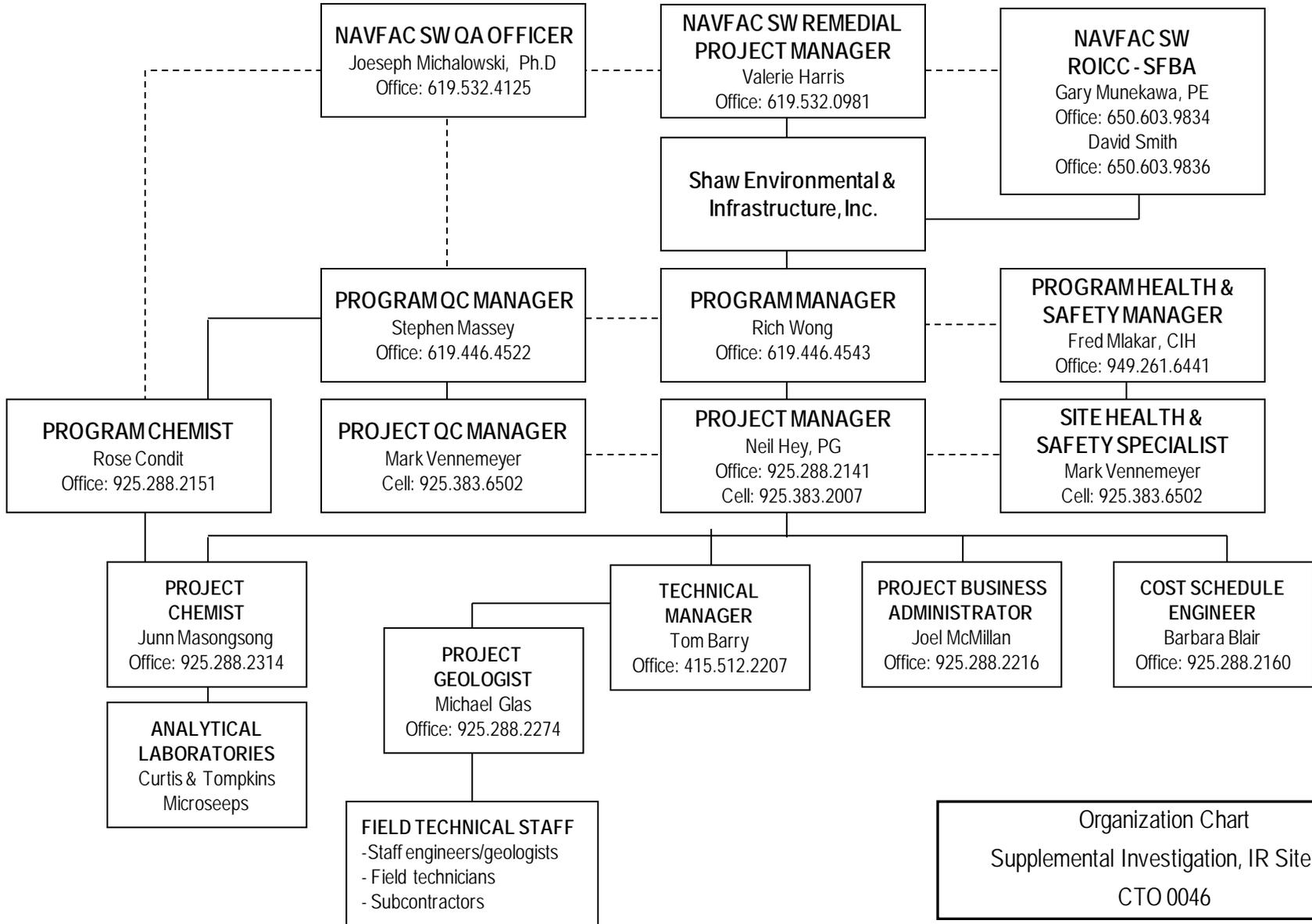
3.0 References

Naval Facilities Engineering Command Environmental Services, 2010, *Quality Control Plan, NAVFAC Environmental Services*, San Diego, California, July 26.

Shaw Environmental & Infrastructure, Inc. (Shaw), 2010a, *Construction Quality Management Plan, Radiological Environmental Multiple Award Contract (RADMAC) for Environmental Remediation Services of Radiological Contaminants at Various Locations within the Naval Facilities Engineering Command, Southwest and Atlantic Areas of Responsibility and Other Department of Defense Locations Nationwide*, Contract Number N62473-10-D-0807, April 20.

Shaw, 2012, *E&I Standard Operating Procedures*, <<http://shawnetv2.shawgrp.com/sites/govern/pp/ei/default.aspx>> (January 2012).

Attachment 1
Quality Control Organization Chart



Organization Chart
 Supplemental Investigation, IR Site 28
 CTO 0046

Attachment 2
Project Quality Control Duties and Responsibilities

Project Quality Control Duties and Responsibilities

Duty	Responsibility	QCD
Pre-Construction Phase		
Establish personnel requirements	QC Manager or Delegate	1.0
Review personnel resumes	QC Manager or Delegate	1.0
Prepare organization chart	QC Manager or Delegate	1.0, 2.0
Prepare letters of designation	QC Manager or Delegate	1.0, 2.0
Assign duties	QC Manager or Delegate	1.0, 2.0
Prepare submittal register	QC Manager or Delegate	2.0, 6.0
Prepare Definable Features of Work Matrix	QC Manager or Delegate	2.0, 9.0
Prepare Testing Plan and Log	QC Manager or Delegate	2.0, 7.0, 11.0
Prepare Rework Items List	QC Manager or Delegate	2.0, 7.0
Identify subcontractors	QC Manager or Delegate	1.0, 2.0
Submit laboratory information	QC Manager or Delegate	1.0, 2.0
Assemble forms	QC Manager or Delegate	2.0
Conduct Coordination and Mutual Understanding Meeting	QC Manager or Delegate	4.0
Construction Phase		
Review definable features of work	QC Manager or Delegate	9.0
Ensure submittals approved and submitted	QC Manager or Delegate	6.0
Conduct Preparatory Meeting	QC Manager or Delegate	9.0
Conduct Preparatory Inspection	QC Manager or Delegate	9.0
Conduct Initial Inspection	QC Manager or Delegate	9.0
Conduct Project QC meetings	QC Manager or Delegate	5.0
Prepare daily QC reports	QC Manager or Delegate	7.0
Conduct Follow-Up Inspection	QC Manager or Delegate	9.0
Conduct Completion Inspections	QC Manager or Delegate	10.0

Notes:

The Project QC Manager may assign the Lead for inspections to the other project personnel: Technical Task Leader (e.g., Project Engineer), or Operational Task Leader (e.g., Project Chemist).

QC *quality control*
 QCD *quality control directive*

Attachment 3
Project Quality Control Manager Letter of Designation, Resume, and
Construction Quality Management Training Certificate

**Supplemental Investigation, IR Site 28,
Former Naval Air Station Moffett Field
Moffett Field, CA**

**Contract Number N62473-10-D-4009
Contract Task Order 0046**

**Project Quality Control Manager
Letter of Designation**

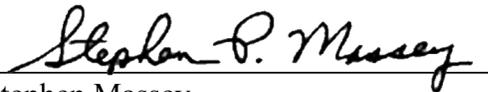
June 28, 2012

Mr. Mark Vennemeyer:

This letter will serve to assign you as the Shaw Project Quality Control (QC) Manager for the above-captioned contract task order. In the case where you are not able to perform the Project QC Manager's duties, Mr. Lee Laws, Mr. Eric Watabayashi, or Mr. David Peet will serve as your Alternate Project QC Manager. Additionally, you are granted stop work authority and will exercise this authority consistent with Shaw Environmental & Infrastructure, Inc. policies and procedures. You are granted the authority to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work. In this capacity, you will report directly to me and will administer the established requirements of the Construction QC Plan.

If you have any questions or require additional information, please contact me at 619.446.4522.

Sincerely,
Shaw Environmental & Infrastructure, Inc.



Stephen Massey
Program QC Manager

Mark J. Vennemeyer

Professional Qualifications

Mr. Vennemeyer has performed waste management activities for twelve (12) years for a variety of clients. At present, he is a Construction Quality Control Manager and has served as Transportation and Disposal Coordinator for Shaw's Government Services division in California. He is responsible for ensuring quality standards of workmanship on various projects, inspection of activities and adherence with contractual requirements, waste characterization/classification, packaging, scheduling, regulatory oversight, providing technical assistance to the Procurement department in matters of Waste Transportation and Disposal Subcontracts, waste sampling, coordination and management of resources necessary to perform off-site transportation and disposal, preparation of waste profiles and shipping papers, and tracking waste shipments to ensure compliance with all applicable regulations.

Mr. Vennemeyer is experienced in "unknown" identification, Treatment Technology requirements, Federal and State (California) waste regulations, and database management. He has been involved in a multitude of waste shipments covering a wide variety of waste streams.

Education

Bachelor of Science, Chemistry, University of California, Irvine, Irvine, California, 1992

Additional Training/Continuing Education

First Aid / CPR, Concord, CA, 2007

Site Safety Officer, Irvine, CA, 2006

Construction Quality Management for Contractors, Sacramento, CA, 2005

Shipping Hazardous Materials by UPS, San Jose, CA, 2005

IATA Dangerous Goods Shipment, Emeryville, CA, 2004

Hazardous Waste Manifesting, Alameda, CA, 2002

Cyanide Training, Richmond, CA, 1998

Hazardous Waste Supervisor, Richmond, CA, 1998

Hazard Categorization, San Jose, CA, 1995

Emergency Response Training, San Jose, CA, 1995

Radiation Worker 2, Lawrence Livermore National Lab, 1994

40-Hour Hazardous Waste Operations, Sacramento, CA, 1992

Experience and Background

06/2007 - present

Quality Control Manager / Site Health and Safety Officer, Shaw Environmental & Infrastructure, Inc., Government Services, Alameda, California

Quality Control manager and Site Safety officer at the Alameda Point project(s). Projects included construction of in-situ Remediation systems (DVE for petroleum contamination, 6-phase underground heating for DNAPL plume).

04/2006 - 06/2007

Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Government Services, San Francisco, California

Served as Quality Control Manager and T&D Coordinator at former Treasure Island naval base. Acted as liaison between Navy construction personnel (engineers, Construction technicians) and Shaw. Provided daily reporting and documentation of activities performed each day.

12/2005 - 04/2006

Quality Control Manager / Inspector, Shaw Environmental & Infrastructure, Inc., Government Services, San Diego, California

Worked with operations personnel to establish QC procedures and documentation of Navy owned Treatment, Storage and Disposal facility. Inspection of satellite facility(ies) for compliance to Navy and regulatory requirements.

02/2005 - 11/2005

Construction Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Government Services, Concord, California

Responsibilities include support of client projects as quality control manager. Also responsible for interaction with client's technical representatives, preparing portions of reports, oversight of field work, inspection of materials and work performed.

The following is a summary of key projects:

Quality Control Manager, Crow's Landing Flight Facility, 836557, 100358, 101454, U.S. Navy, Crow's Landing Flight Facility, 02/2005 - Present

Quality Control manager for Crow's Landing Flight Facility in Crow's Landing, CA. The project involved several contract task orders (CTOs) to perform different remedial actions. The highlights included:

Removal action of waste soil and debris at former waste pits. Investigation of potential Munitions and Explosives of Concern sites using non-intrusive geophysical surveys and exploratory trenching.

Awards/Client Commendations:

President's Safety Award

05/2002 - 02/2005

Transportation and Disposal Coordinator, Shaw Environmental & Infrastructure, Inc., Government Technical Services, Concord, California

Responsibilities include providing technical support for clients as a transportation and disposal coordinator. Also responsible for waste characterization, profiling, manifesting, coordination of subcontractors and disposal facilities for remedial actions, waste tracking and technical documentation of removal / disposal actions.

The following is a summary of key projects:

T&D Coordinator, Carmel Valley Manor, , JM Electric, Carmel, CA, \$20,000.00, 03/2005 - 03/2005

Removal and disposal of aged transformers and electrical equipment. Tasks included sampling, characterizing, profiling, manifesting, packaging of equipment according to all applicable federal,

state and local regulations.

Transportation and Disposal Coordinator, Hunters Point Shipyard, various, U.S. Navy, San Francisco, CA, 02/2002 - 02/2005

Transport and Disposal Coordinator for various projects at Hunters Point. Responsible for waste sampling, characterization, profiling, manifesting, coordination of waste shipments and technical documentation of disposal activities.

During the span of the project, over 20,000 tons of waste was removed from site and sent to various permitted treatment/disposal facilities.

Transportation and Disposal Coordinator, Alameda Point, former Alameda Naval Air Station, various, U.S. Navy, Alameda, CA, 02/2002 - 02/2005

Coordination of disposal activities for various remedial projects at the Former Alameda Naval Air Station. Tasks included Investigation Derived and Treatment by-product Waste sampling, characterization, profiling, manifesting and coordination of disposal.

Awards/Client Commendations:

President's Safety Award

Transport and Disposal Coordinator, ORC - Cyril, 100735, US EPA, Cyril, OK, \$6,000,000.00, 09/2003 - 06/2004

Demolition of a shut-down oil refinery. Disposal of all wastes associated with the facility including petroleum by-products, chemical catalysts, construction demolition debris, abandoned drummed wastes and "laboratory size" chemical bottles.

Much of the structure was recycled as scrap metal, but the area was cleared of Asbestos prior to any demolition activities starting.

Transport and Disposal Coordinator, Hamilton Army Airfield, US Army Corp of Engineers, Novato, CA, 05/2002 - 12/2002

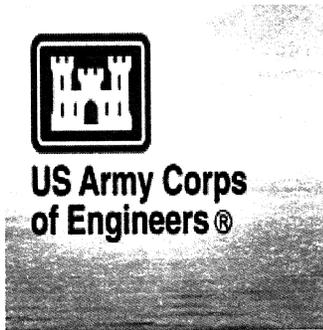
This project was the removal from site and disposal of several thousand tons of waste excavated soil that was staged on site at an Army Airfield that was in closure. Tasks included classification of waste based on analytical results of samples, profiling of waste to selected TSDFs, tracking of waste shipments (using the manifest shipping documents) and confirmation of costs associated with transportation and disposal of waste.

12/2000 - 02/2002

Transportation and Disposal Coordinator, IT Corporation (The Shaw Group Inc. acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2002), Government Services, Concord, California

Responsibilities included providing technical support to client projects as Transport and Disposal coordinator. Also responsible for field support of waste disposal operations, support of business development activities and composition of certain technical sections of reporting documents.

**NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST
U.S. ARMY Corps of Engineers**



PRESENTS THIS CERTIFICATE TO

Mark Vennemeyer

WHO HAS SUCCESSFULLY COMPLETED

January 28 & 29, 2010

U.S.A.C.E. Construction Quality Management for Contractors

Kugan Panchadsaram PE, PMP
CQM Facilitator
Kugan & Associates Inc.



**San Diego
Chapter, Inc**

"Building Your Quality of Life"

Glen Schaffer
AGC-San Diego Director of Marketing & Education
CQM Training Coordinator

This Certificate is valid for 5 years from the date above

Attachment 4
***Alternate Project Quality Control Manager Letter of Designation,
Resume, and Construction Quality Management Training Certificate***

**Supplemental Investigation IR Site 28,
Former Naval Air Station Moffett Field
Moffett Field, CA**

**Contract Number N62473-10-D-4009
Contract Task Order 0046**

**Alternate Project Quality Control Manager
Letter of Designation**

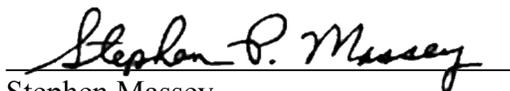
June 28, 2012

Mr. Lee Laws/Mr. Eric Watabayashi/Mr. David Peet:

This letter will serve to assign you as Shaw Alternate Project Quality Control (QC) Manager for the above-captioned contract task order. In the case where the designated Project QC Manager, Mr. Mark Vennemeyer, is unable to perform the Project QC Manager's duties, you will serve in that capacity. In this role, you will have his responsibilities and authorities. Additionally, you are granted stop work authority and will exercise this authority consistent with Shaw Environmental & Infrastructure, Inc. policies and procedures. You are granted the authority to approve submittals that have been certified by qualified submittal reviewers as identified in the organization chart for this task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work. You will be authorized to act as an alternate for two weeks at one time and not more than 30 workdays during a calendar year. In the case where it is believed that these time periods will be exceeded, you must notify me. You will report directly to me and will administer the established requirements of the Construction QC Plan.

If you have any questions or require additional information, please contact me at 619.446.4522.

Sincerely,
Shaw Environmental & Infrastructure, Inc.



Stephen Massey
Program QC Manager

Lee H. Laws

Professional Qualifications

Mr. Laws has more than 16 years of QA/QC experience with IT Corporation and The Shaw Group (May 2002 - Present), functioning since 1996, as Project QC Manager on the Navy EFA West Remedial Action Contract (RAC). This project experience has encompassed all phases of CERCLA Removal and Remedial Action cleanups, Superfund and National Priority List (NPL) sites, and numerous petroleum cleanups (e.g., USTs, ASTs) at federal facilities, industrial and residential properties under contracts from the U.S. Navy, U.S. Army Corps of Engineers (USACE), and U.S. Department of Energy (DOE).

Since 1999, Mr. Laws has served as the Lead QC Manager at Naval Station Treasure Island/Yerba Buena Island, which is a top priority Base Realignment and Closure (BRAC) base on the \$250M Navy EFA West RAC. During this time period, the project backlog has grown to 16 environmental cleanup Contract Task Orders (CTO's 006, 012, 016, 036, 039, 040, 043, 045, 046, 089, 099, 102, 105, 106, 131, 134) with a total budget of over \$37M, including a current backlog of over \$20M. Treasure Island CERCLA, RCRA and petroleum cleanup projects have been executed with a high degree of involvement and oversight from the Navy, City of San Francisco, State and County regulatory agencies and local citizen groups who occupy the impacted property.

In support of this growing basewide cleanup program, Mr. Laws has prepared all CTO QC plans, provided ongoing project team and subcontractor coordination of task-specific QC inspections (including interface with two Government QA Resident Officers in Charge of Construction), and maintained all project QC documentation in a cost-effective MS-Access database. Mr. Laws produces project deliverables, including QC records and technical reports, in Adobe (pdf) format on CD-ROM, which substantially reduces project cost. Navy EFA West RAC six-month performance evaluations have consistently rated the Treasure Island QC Program "Level 1 - Outstanding," which has translated into an additional \$1,664,316 of award fee profit (to-date) to IT Corporation and The Shaw Group

Education

High School Diploma, General Education, Pittsburg High Schol, Pittsburg, California, 1983

Additional Training/Continuing Education

USACE CQM Training, Sacramento, 2004

DHS Lead Supervisor/Monitor, UC Berkeley, 2000

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 2004, Active, Nationwide, 11/2008

Experience and Background

05/2002 - Present

Project QC Manager, Shaw Environmental & Infrastructure, Inc., Quality, Concord, California

2002 - Present IT Corporation/Shaw Environmental & Infrastructure, Concord, California.
Project QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC)

Naval Station Treasure Island, San Francisco, California.

Currently serve as the Lead QC Manager. Responsible for the planning, development and project team implementation of Project QC Plans and documentation on 10 environmental cleanup contract task orders with a total budget of over \$37M. Projects involve the design, construction, operation, optimization and maintenance of remediation action systems (e.g., Soil Vapor Extraction); soil sampling, analysis, excavation, treatment, transportation and disposal; and site restoration in sensitive public housing areas. Mr. Laws effectively plans, coordinates and verifies task-specific QC inspections with Task Leaders, the Site Health & Safety Officer, Navy Resident Officers in Charge of Construction (ROICCs) and subcontractors. Mr. Laws also performs independent quality assurance audits, surveillances, and inspections of laboratories and field project activities to verify compliance with established QA program requirements

10/1996 - 05/2002

Project QC Manager, IT Corporation, Martinez, California

1996 - 2002 IT Corporation/Shaw Environmental & Infrastructure, Concord, California.
Project QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC)

Naval Station Treasure Island, San Francisco, California.

Currently serve as the Lead QC Manager. Responsible for the planning, development and project team implementation of Project QC Plans and documentation on 10 environmental cleanup contract task orders with a total budget of over \$37M. Projects involve the design, construction, operation, optimization and maintenance of remediation action systems (e.g., Soil Vapor Extraction); soil sampling, analysis, excavation, treatment, transportation and disposal; and site restoration in sensitive public housing areas. Mr. Laws effectively plans, coordinates and verifies task-specific QC inspections with Task Leaders, the Site Health & Safety Officer, Navy Resident Officers in Charge of Construction (ROICCs) and subcontractors. Mr. Laws also performs independent quality assurance audits, surveillances, and inspections of laboratories and field project activities to verify compliance with established QA program requirements.

China Lake Naval Air Weapons Station, Ridgecrest, California.

Served as the Project QC Manager. Responsible for the implementation of the site specific work plans and the quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan, specifications and requirements based on the program contract. Responsibilities also included performing reviews of documentation and the preparation of daily CQC reports that were submitted to the Navy on the next business morning.

Naval Communication Station, Stockton, California.

Served as the Site Health and Safety Officer. Responsible for providing independent surveillance of the routine implementation of the site safety and health plan. Conducted daily Tailgate Safety Meetings, verified personnel had necessary training and medical clearance to enter work area, performed daily equipment calibrations, monitored personnel for compliance with site safety and health plans, and performed monthly safety inspections.

Yerba Buena Island Housing, Yerba Buena, California.

Served as the Project QC Manager for Lead Base Paint Abatement. Responsible for the implementation of the site specific work plans and the quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports, which were submitted to the Navy on the next business morning.

Alameda Naval Air Station, Alameda, California.

Served as the Project QC Manager and Site Superintendent. Responsibilities included implementation of the site specific work and quality control plans. Also responsible for daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Also performed reviews of documentation and prepared daily CQC reports, which were submitted to the Navy on the next business morning. My responsibilities as Site Superintendent included daily production, scheduling activities, ordering equipment and site safety.

Department of Defense Housing, Novato, California.

Served as the Project QC Manager. Responsible for the implementation of the site specific work and quality control plans, as well as daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports that were submitted to the Navy on the next business morning.

Naval Medical Center, Oakland, California.

Served as the Project QC Manager. Responsible for the implementation of the site specific work and quality control plans in addition to daily field inspections to ensure that all work was performed in accordance with the work plan specifications and requirements, which were based on the program contract. Responsibilities included performing reviews of documentation and the preparation of daily CQC reports which were submitted to the Navy on the next business morning.

08/1995 - 10/1996

Quality Control Coordinator, IT Corporation, San Jose, California

1995 - 1996 IT Corporation, San Jose, California

Quality Control Coordinator, Engineers Services

Responsible for field QC activities, ensuring that fieldwork was being performed in accordance with the requirements written in the project work plans and procedures. Specific project experience and responsibilities included:

Hamilton Army Air Field, Novato, California.

Served as a Quality Control Inspector for the QC group. Responsible for daily field inspections and the preparation of daily QC reports. Performed reviews of documentation and other duties designated by the Program QC Manager.

07/1993 - 08/1995

Field Analytical Specialist II, IT Corporation, Field Analytical Services, Martinez, California

1993 - 1995 IT Corporation, Martinez, California

Field Analytical Specialist II, Field Analytical and Sampling (FAS)

Responsible for organizing and participating in field analytical and sampling activities. Ensured sample protocols were followed, and coordinated between field and laboratory to meet project needs. Specific project experience and responsibilities included the following:

IBM, San Jose, California.

Served as a "lead man" for a demolition crew of three to six employees. Responsible for guidance and inspection of crew's work. Insured health and safety around work area.

MCAGCC, Twenty Nine Palms, California.

Served as the sample coordinator working with the Jacobs Engineers Group Navy/Clean program at this DOE Superfund site. Acted as Liaison between the field and the laboratory: ordering glassware, coordinating sampling, documenting sampling, and maintaining the field database.

03/1989 - 07/1993

Assistant Field Analytical Specialist, IT Corporation, Martinez, California

1989 - 1993 IT Corporation, Martinez, California

Assistant Field Analytical Specialist, Field Analytical and Sampling (FAS)

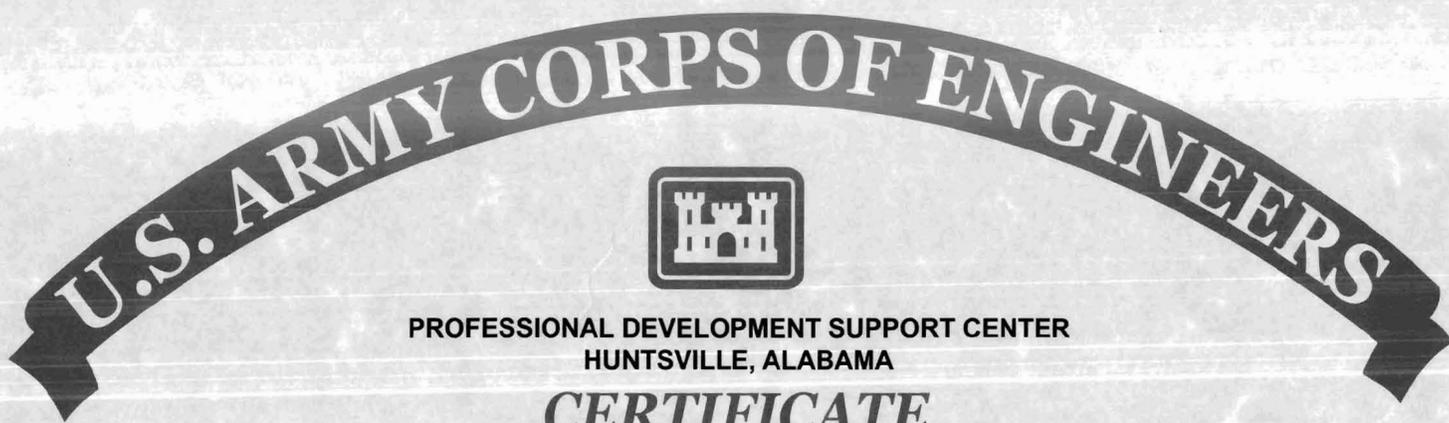
Responsible for environmental monitoring on various RI/FS projects in the Western United States. Primary responsibilities were groundwater compliance, soil organic vapor sampling, and soil sampling. Some specific experience include the following:

Mather Air Force Base, Rancho Cordova, California.

Served as a sample team leader in the areas of SOV, soil, and groundwater sample collection. Trained new employees in proper sampling and documentation procedures. Responsible for providing instruction and performing tasks in the areas of monitoring well development, dedicated pump and packer installation, and proper operation of such equipment. Gained experience with sample collection around drill rigs and a clearance for work on military flight lines. Acted as liaison between the field and analytical laboratory. Fulfilled the Sample Coordinator's position in his absence.

Castle Air Force Base, Merced, California.

Served as Assistant Sample Coordinator during this major RI/FS project. Acted as liaison between the field operations and the office. Helped supervise the groundwater sampling and pump installation phases of the project.



PROFESSIONAL DEVELOPMENT SUPPORT CENTER
HUNTSVILLE, ALABAMA

CERTIFICATE

This is to certify that

LEE LAWS

has completed the Corps of Engineers Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS

Given at Sacramento, CA By Sacramento 15 & 16 JUL 2009
Location Instructional District Date

Expires: July 16, 2014

Verification (916) 557-7708

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE

Norbert F. Suter
Facilitator

Gary Z Anderson
Chief, USAACE Professional Development Support Center

Eric M. Watabayashi

Professional Qualifications

Mr. Watabayashi has 32 years of diverse management experience in the areas of QA/QC, production and safety. Throughout his career he has directed and supported QA/QC programs and projects, including those of remedial action contracts with the U.S. Navy, U.S. Army Corps of Engineers, U.S. Air Force Center for Engineering and the Environment, and commercial clients. These contracts have encompassed all phases of CERCLA removal and remediation actions, Superfund and National Priority List sites, and petroleum cleanups at federal facilities, including industrial and residential properties. He has also been Project Superintendent on small remedial projects.

Serving as Site Safety and Health Manager for remedial construction projects and a ships' Safety Officer, he enforced their safety programs.

As a commissioned officer in the U.S. Navy, he implemented the nuclear weapons surety program. He was also responsible for the quality of maintenance and repair of mechanical, hydraulic, electrical, and electronic systems.

Education

Bachelor of Arts, Applied Mathematics, University of California Berkeley, Berkeley, California, 1978

Additional Training/Continuing Education

Medic First Aid, Concord, CA, 2010
OSHA HAZWOPER Refresher 8 Hours per 29 CFR 1910.120, Concord, CA, 2010
Apollo Root Cause Analysis for Practitioners, Seattle, WA, 2010
Asbestos Building Inspection & Management Planning, Richmond, CA, 2009
Unexploded Ordnance Safety Training Program, Vallejo, CA, 2009
OSHA 10-Hour Construction Safety, Concord, CA, 2008
Competent Person: Drilling Oversight (CPDO), Concord, CA, 2006
Site Safety Officer, Irvine, CA, 2005
Uniform Federal Policy for Quality Assurance Project Plans, San Diego, CA, 2005
Supervision of Hazardous Waste Operations per OSHA 29 CFR 1910.120, Irvine, CA, 2005
Excavation Competent Person Training, Irvine, CA, 2005
Confined Space - Entry Supervisor (Ent. & Attn.), Irvine, CA, 2005
Air Shipping Dangerous Goods by IATA per HM-126 and IATA, Martinez, CA, 2000
Lead-Based Paint Supervision and Monitoring, Richmond, CA, 1997
Hazards & Protection Waste Operations 40 Hours per 29 CFR 1910.120, Martinez, CA, 1994
U.S. Navy Total Quality Management, San Diego, CA, 1993
U.S. Navy Instructor Training, San Diego, CA, 1993
U.S. Navy Quality Control Inspector, San Diego, CA, 1992
U.S. Navy Safety Officer, Pearl Harbor, CA, 1986

Registrations/Certifications/Licenses

USACE Construction Quality Control Manager, 1999, Active, Nationwide, 01/2015

Experience and Background

11/2009 - Present

QC Supervisor on U.S. Army Corps of Engineers (USACE) Total Environmental Remediation Contract (TERC), Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi is responsible for overseeing the QC program. He assisted in establishing and maintains Program Management Office requirements and procedures. He trains, assigns and supervises Contractor QC System Managers. Routine duties include writing and approving Project QC Plans.

11/2009 - Present

Contractor Quality Control Systems Manager on U.S. Army Corps of Engineers (USACE) Environmental Remediation Services (ERS) Contract, Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi is responsible for overseeing the QC program. He assisted in establishing and maintains Program Management Office requirements and procedures. He trains, assigns and supervises project Contractor QC Systems Managers. Routine duties include writing and approving Project QC Plans and reviewing other project plans and reports. Additionally, he writes quality and other sections for proposals and project plans.

11/2009 - Present

Deputy Program QC Manager on various Naval Facilities Engineering Command Southwest (NAVFAC SW) contracts, Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi is responsible for assisting in overseeing the QC program. He assisted in establishing and helps maintain Program Management Office requirements and procedures. He trains, assigns and supervises Project QC Managers. Routine duties include writing and approving Project QC Plans and reviewing other project plans and reports. Additionally, he writes quality and other sections for proposals and project plans.

07/2009 - 11/2009

Quality Control Manager on Lennar Mare Island Guaranteed Fixed Price Contract, CH2M HILL, Environmental Services, Oakland, California

Mr. Watabayashi was responsible for overseeing the QC program on multiple projects. He trained and assisted field QC personnel, ensuring work was accomplished per contract, plans and specifications. He wrote quality standard operating procedures and conducted root cause analyses.

12/2008 - 11/2009

Site Health and Safety Manager on Lennar Mare Island Guaranteed Fixed Price Contract, CH2M HILL, Environmental Services, Oakland, California

Mr. Watabayashi was responsible for managing the health and safety program for as many as six

projects in the field at the same time on this \$50 million contract. Activities included excavation; backfilling and compacting; demolition; lead-based paint and asbestos abatement; confined space entry; natural gas and sewer line restoration; paving; drilling; direct push; air monitoring; groundwater, soil and soil vapor sampling. Routine duties included managing behavior-based loss prevention system; conducting site inspections; resolving health safety discrepancies; writing incident reports; and conducting health and safety training. He wrote the Program Health and Safety Plan and writes and approves project-specific Health and Safety Plans.

04/2006 - 12/2008

Contractor Quality Control Systems Manager on U.S. Army Corps of Engineers (USACE) Environmental Remediation Services (ERS) Contract, Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi was responsible for overseeing the QC program. He assisted in establishing and maintaining Program Management Office requirements and procedures. He trained, assigned and supervised project Contractor QC Systems Managers. Routine duties included approving Project QC Plans. Additionally, he wrote plans, in support of program and project activities.

05/2005 - 12/2008

QC Supervisor on U.S. Army Corps of Engineers (USACE) Total Environmental Remediation Contract (TERC), Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi was responsible for overseeing the QC program. He assisted in establishing and maintaining Program Management Office requirements and procedures. He trained, assigned and supervised Contractor QC System Managers. Routine duties included approving Project QC Plans. Additionally, he wrote plans, in support of program and project activities.

05/2005 - 12/2008

Program QC Manager on Naval Facilities Engineering Command Southwest (NAVFAC SW) Environmental Multiple Award Contract, Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi was responsible for overseeing the QC program. He assisted in establishing and maintaining Program Management Office requirements and procedures. He trained, assigned and supervised Contractor QC System Managers. Routine duties included approving Project QC Plans and helping write proposals. Additionally, he wrote plans, in support of program and project activities.

03/2005 - 12/2008

Program QC Manager on Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC), Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi was responsible for overseeing the QC program. He assisted in establishing and maintaining Program Management Office requirements and procedures. He teamed with U.S. Navy personnel, resolving key program level issues, basing his input on over ten years of experience with RAC contracts. He trained, assigned and supervised Project QC Managers. Routine duties included approving Project QC Plans. Additionally, he wrote plans, procedures and reports, normally done by the technical staff, in support of program and project activities.

05/2002 - 12/2008

Project QC Manager, Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi was responsible for the maintenance and administration of the quality program in field projects. Routine tasks included: inspecting work for compliance with project plans, specifications and permits; identifying and tracking work variances, non-conforming work, and rework items; reviewing as-built drawings; chairing QC meetings with the client; reviewing and approving administrative and technical submittals; and producing daily reports to the client.

The following is a summary of key projects:

Project QC Manager, Site Health and Safety Supervisor, IR Site 12 Soil Excavation, 122412, U.S. Navy, Treasure Island, California, \$15,000,000.00, 06/2008 - Present

Soil removal contaminated with lead and radium-226. Activities included excavating, radiation surveys and air monitoring, backfilling, compacting, land surveying, soil sampling, data management, and lead air monitoring. Ensured work and testing were accomplished per project plans, including Radiation Protection Plan and radiation work permits. As Site Health and Safety Officer, oversaw the health and safety program for approximately 50 on site personnel, conducted realtime aerosol monitoring and high-volume perimeter air monitoring.

Project QC Manager, Soil Remedial Action, 117092, U.S. Air Force, Travis AFB, California, \$3,700,000.00, 05/2007 - 12/2008

Soil removal at seven sites contaminated with lead, PCB, and dioxin; and construction of corrective action management unit (CAMU). Activities included excavating, soil sampling, data management, XRF soil screening, bentonite-soil mixing, backfilling, compacting, grading, land surveying, soil testing, hydroseeding, and AST removal. Ensured work and testing were accomplished per project plans and permits, and CAMU was constructed per design specifications.

Project QC Manager, Petroleum Fuel Corrective Actions, 843778, 123139, 123533, U. S. Navy, Alameda, California, \$17,000,000.00, 07/2001 - 05/2007

Dual vacuum extraction and biosparging systems at ten petroleum hydrocarbon contaminated soil and groundwater remediation sites. Activities included hydropunch groundwater sampling, direct push soil sampling, CPT, indoor and ambient air sampling, data management, well installation and development, soil excavation and backfilling, storm sewer system repair, and AST and UST removal. Ensured systems were constructed and tested per plans and operations and maintenance were conducted per instructions, schedules and permits. Wrote work variances and field activity reports.

Awards/Client Commendations:

Shaw Environmental and Infrastructure, Inc. President's Award

Project QC Manager, Six-Phase Heating, 819856, 108816, 124716, U.S. Navy, Alameda, California, \$14,800,000.00, 07/2001 - 05/2007

Pilot test and full-scale six-phase heating of DNAPL and dissolved source. System included high voltage electrical power, transformer panel assembly, power supply and control wiring, piping, pumps, blowers, security alarm system, sheet piling, well installation, hydropunch groundwater sampling, soil coring, CPT, soil radiation screening, and DNAPL extraction. Ensured proper construction and operation and maintenance of the six-phase heating system is per design. Oversaw electrical, pneumatic, and six-phase heating system testing, and operation and maintenance.

Awards/Client Commendations:

Shaw Environmental and Infrastructure, Inc. President's Award

Project QC Manager, In-Situ Chemical Oxidation, 844918, U.S. Navy, Alameda, California, \$7,500,000.00, 07/2001 - 09/2006

In-situ chemical oxidation at five sites contaminated with dissolved-phase chlorinated and aromatic hydrocarbons, using a modified Fenton's approach. Activities included hydropunch groundwater sampling, direct push soil sampling, CPT, and well installation and development. Ensured proper chemical injections and monitoring. Coordinated field activities with commercial tenants.

Project was modified to include a time-critical removal action to minimize the risk of PAH exposure at an elementary school and child development center. Removal and restoration were accomplished in close quarters and while children were present. He wrote the work plan and final report for this removal action.

Awards/Client Commendations:

Shaw Environmental and Infrastructure, Inc. President's Award

Project QC Manager, Basewide Groundwater Monitoring, 843780, U.S. Navy, Alameda, California, \$3,400,000.00, 04/2003 - 01/2005

Base-wide quarterly groundwater monitoring. Activities included groundwater sampling in 220 monitoring wells, CPT, sonic drilling well installation, well abandonment, down hole video logging, UXO clearance, and radiological survey.

Awards/Client Commendations:

Shaw Environmental and Infrastructure, Inc. President's Award

Project QC Manager, Closure of IWTPs 25 and 32, 101643, U.S. Navy, Alameda, California, \$1,500,000.00, 02/2004 - 07/2004

Demolished two IWTPs. Activities included demolition, groundwater sampling, and direct push soil sampling.

Awards/Client Commendations:

Shaw Environmental and Infrastructure, Inc. President's Award

05/2002 - 03/2005

Deputy Program QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC), Shaw Environmental & Infrastructure, Inc., Federal QA/QC, Concord, California

Mr. Watabayashi was responsible for assisting the Program Quality Control Manager in overseeing the QC program. He assisted in establishing and maintaining Program Management Office requirements and procedures. He teamed with U.S. Navy personnel, resolving key program level issues, basing his input on over ten years of experience with RAC contracts. He trained, assigned and supervised Project QC Managers. Routine duties included approving Project QC Plans. Additionally, he wrote plans, procedures and reports, normally done by the technical staff, in support of program and project activities.

11/1997 - 05/2002

Deputy Program QC Manager on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC), IT Corporation, QA/QC, Concord/Martinez, California

Mr. Watabayashi was responsible for assisting the Program Quality Control Manager in overseeing the QC program. He assisted in establishing and maintaining Program Management Office requirements and procedures. He teamed with U.S. Navy personnel, resolving key program level issues, basing his input on over ten years of experience with RAC contracts. He trained, assigned and supervised Project QC Managers. Routine duties included approving Project QC Plans. Additionally, he wrote plans, procedures and reports, normally done by the technical staff, in support of program and project activities.

08/1994 - 05/2002

Project QC Manager, IT Corporation, QA/QC, Concord/Martinez, California

Mr. Watabayashi was responsible for the maintenance and administration of the quality program in field projects. Routine tasks included: inspecting work for compliance with project plans, specifications and permits; identifying and tracking work variances, non-conforming work, and rework items; reviewing as-built drawings; chairing QC meetings with the client; reviewing and approving administrative and technical submittals; and producing daily reports to the client. As the Alameda Point Installation QC Manager, he oversaw fifteen projects, some directly and others managing a Project QC Manager.

The following is a summary of key projects:

Project Superintendent, Project QC Manager, Site Health and Safety Specialist, UST Site Closure, 830722, U.S. Navy, Stockton, California, \$170,000.00, 03/2002 - 03/2002

Served as Project QC Manager, Project Superintendent, and Site Health and Safety Specialist for a project, involving investigation, remediation, and closure of former UST sites. Scheduled and supervised field work, including asbestos-containing material and lead-based paint abatement, building demolition, excavation, backfilling, compaction, and soil and hydropunch groundwater sampling. Directed backfill compaction field testing. Wrote project final report.

Project QC Manager, Investigation and Remediation of Various Sites, 800063, U.S. Navy, Crows Landing, California, \$8,000,000.00, 10/1999 - 07/2001

Investigation and remediation of various sites. Included were soil vapor extraction and aquifer testing; ARCH rig well installation and abandonment; geophysical, unexploded ordnance, and sewer pipe video surveys; and quarterly groundwater sampling. Ensured the accuracy of test measurements used to determine remediation designs. Acquired required permits and ensured compliance. Wrote field activity report.

Contractor QC Manager, UST Cluster 1 Remediation, , U.S. Navy, Crows Landing, California, \$1,000,000.00, 05/1998 - 04/1999

Bioventing and biosparging treatment system construction. Directed QC activities in the construction, checkout and startup. Reviewed and approved technical submittals, and ensured that the construction of mechanical, pneumatic, electrical, electronic, and structural systems were per project specifications and drawings, and applicable building codes. Tested the systems in accordance with test plans and wrote test reports. Updated red-lined drawings. Acquired required permits and ensured compliance. Wrote project final report.

Contractor QC Manager, UST/Pipeline Removal, , U.S. Navy, Alameda, California, \$8,000,000.00, 09/1997 - 03/1998

UST and underground fuel pipeline removal. Assured that 13 miles of pipe and five USTs were removed per the Navy's and various agencies' requirements. QC activities involved trenching; soil backfilling, compacting and testing; concrete and asphalt paving and testing; soil and water sampling, and field and fixed laboratory analyses; asbestos and lead-based paint abatement; pipe hydro blasting and pressure grouting; building demolition; hazardous waste manifesting and disposal; confined space entry; air monitoring; and hydro seeding. Project finished ahead of schedule.

Contractor QC Manager, Sites 1 and 2 Landfill Consolidation and Cap, , U.S. Navy, Moffett Field, California, \$3,000,000.00, 04/1997 - 09/1997

Landfill consolidation and cap. 20,000 cubic yards of waste from a five acre landfill were consolidated into a 12 acre landfill which was subsequently capped. Assured that 75,000 cubic yards of earthwork and installation of synthetic liners, including extensive soil testing and land surveying, met stringent specifications requirements. Inspected the successful installation of monitoring and landfill gas migration wells; gas vents; groundwater extraction and gas venting trenches; a maintenance road; a storm drain catch basin, drainage ditches, swales, and culverts; and permanent fences. Also inspected soil and water sampling, de-watering, and hydro seeding.

Contractor QC Manager, Site 18 - Storm Drain System, , U.S. Navy, Alameda, California, \$2,000,000.00, 07/1996 - 03/1997

Cleaned twelve miles of storm sewer lines. Work included water jetting and video taping sewer pipes up to 48 inches in diameter, and construction and operation of a water filter system. Responsible for determining visual acceptable cleanliness of sewer pipes. Tracked progress of line cleaning and video taping. Ensured water filter system was constructed per design. Received letter of appreciation from the Navy for accomplishing the work under challenges, including working around occupied housing and during the rainy season.

Accomplishments:

U.S. Navy Letter of Appreciation

Contractor QC Manager, Cleanup of Hangars 400A and 11, , U.S. Navy, Alameda, California, \$1,000,000.00, 07/1995 - 09/1995

Removed heavy metal contamination in two former aircraft maintenance hangars. Removal was done, using high pressure water from 90-foot man lifts. Responsible for visually determining acceptable cleanliness of surfaces. Project was accomplished in half of the scheduled three months.

Accomplishments:

U.S. Navy Letter of Commendation for finishing under budget and one month ahead of schedule

Contractor QC Manager, Treatment System Construction, U.S. Navy, Moffett Field, California, 12/1994 - 07/1995

Three remedial construction projects, involving sanitary sewer liners, biovent and soil vapor extraction systems, and installation of a storm drain water treatment system. Assured that systems were installed per contract and delivery order specifications. Inspected field work, approved technical and administrative submittals to the government, chaired QC meetings, updated red-line drawings, and researched and generated field changes.

Contractor QC Manager, UST Closure, , U.S. Navy, Fairfield, California, \$2,000,000.00, 08/1994 - 12/1994

UST removal. Inspected excavation activities, UST removal and disposal, soil sampling, hazardous waste manifesting and disposal, earthwork and compaction, confined space entry, and air and noise monitoring. Wrote sections of the UST closure report.

12/1994 - 07/2001

Site Health and Safety Officer on the Navy Engineering Field Activity (EFA) West, Remedial Action Contract (RAC), IT Corporation, H&S, Concord/Martinez, California

Mr. Watabayashi was responsible for the maintenance and administration of the Health and Safety Program in field projects. Additionally, he assisted in writing plans and procedures in support of program and project activities.

The following is a summary of key projects:

Site Health and Safety Specialist, Investigation and Remediation of Various Sites, 800063, U.S. Navy, Crows Landing, California, \$8,000,000.00, 10/1999 - 07/2001

Investigation and remediation of various sites. Health and safety oversight for periods as long as one month. Soil vapor extraction and aquifer testing; well installation and abandonment; geophysical, unexploded ordnance, and sewer pipe video surveys; and quarterly groundwater sampling.

Awards/Client Commendations:

U.S. Navy Letter of Commendation for 62,863 accident-free work hours.

Site Health and Safety Officer, UST Installation, U.S. Navy, Fairfield, California, 12/1994 - 01/1995

UST installation. Administered the Health and Safety programs during excavation activities, including air and noise monitoring.

06/1978 - 09/1994

Surface Warfare Officer, U.S. Navy, San Diego, California

Mr. Watabayashi served in various management positions in ships and shore commands in the Surface Warfare community. Primary positions included the areas of QA/QC of facilities and equipment maintenance (9 years); ordnance maintenance, handling, and storage (6 years); safety (3 years); training (4 years).

As the Nuclear Weapons Officer aboard two different Navy ships, enhanced the safety and surety of weapons handling, maintenance, and storage under absolutely stringent rules for 3 1/2 years. Managed the program for monitoring radiation exposure. "Molded an inexperienced group of men into a proficient team," achieving the "highest recorded grade" in training.

As ships' Department Head, planned and directed four extensive departmental facilities and equipment maintenance periods, overseeing one as the Quality Control Inspector. Coordinated a \$100,000 foreign contracted preservation project.

Responsible for the exterior preservation of a Navy aircraft carrier, Budgeted for \$300,000 worth of paint annually. Controlled paint issue and disposal, and maintenance and instruction on use of personnel protective equipment. Implemented, trained workers on, and enforced new EPA requirements within the organization.

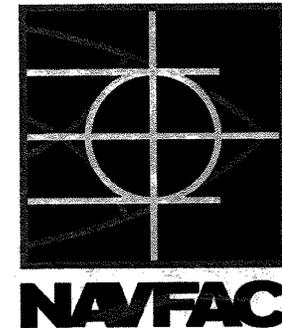
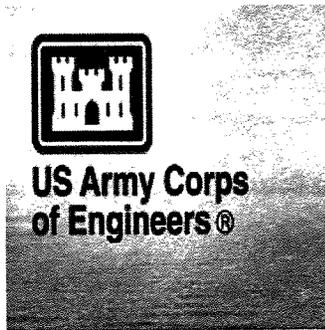
As the Ship's Safety Officer aboard two different Navy ships, wrote the Safety Plan, and administered and enforced the Safety Program. Transformed the organizations' apathetic attitude to that of awareness. His ships had no work days lost throughout the 3 years that he was in charge of the program.

As Assistant Department Head in a large Navy training command, designed and executed the reorganization of his major department. Determined the best organization structure, measured the skills of 230 supervisors, instructors, and schedulers. Completed the reorganization, including a move into a new facility, in a month without customer service interruption.

Awards/Honors

Meritorious Service Medal, U.S. Navy, 1991

**NAVAL FACILITIES ENGINEERING COMMAND
SOUTHWEST
U.S. ARMY Corps of Engineers**



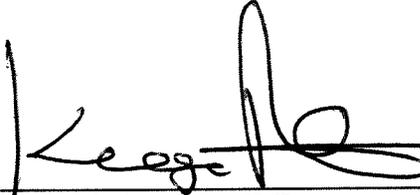
PRESENTS THIS CERTIFICATE TO

Eric Watabayashi

WHO HAS SUCCESSFULLY COMPLETED

January 28 & 29, 2010

U.S.A.C.E. Construction Quality Management for Contractors


Kugan Panchadsaram PE, PMP
CQM Facilitator
Kugan & Associates Inc.



**San Diego
Chapter, Inc**
"Building Your Quality of Life"


Glen Schaffer
AGC-San Diego Director of Marketing & Education
CQM Training Coordinator

This Certificate is valid for 5 years from the date above

David Peet

Professional Qualifications

Mr. Peet was Construction and Operations manager at Sunnyvale Air Force Station for two years, providing Utility, Facility and grounds construction and maintenance management.

Mr. Peet was also a Project QC Manager for Shaw Environmental on the Navy RAC II contract at NASA Crows Landing and on the Navy EMAC II contract at Hunters Point Shipyard. He also has 10 years of environmental sampling and wastewater treatment experience with IT Corporation. In addition, he worked in construction for 20 years providing facility maintenance, management and quality assurance while working at various locations around the world, including Greenland, Germany, Alaska and state-side locations.

Additional Training/Continuing Education

40 Hour OSHA , Oakland, 2009

Registrations/Certifications/Licenses

USACE Construction Quality Management, 2009, Active, Nationwide, 09/2014

Experience and Background

07/2009 - present

Quality Control Manager, Shaw Environmental & Infrastructure, Inc., Concord, California

Quality Control Manager for EMAC II contract at Hunters Point Shipyard, San Francisco, California.

The following is a summary of key projects:

Project QC Manager, Parcel D-1 Radiological Remediation and Support, 136250, US Navy, Hunters Point Shipyard, San Francisco, California, 09/2010 - Present

Screening, excavation, removal and disposal of radiological contaminated material, soil and pipe lines. Demolition of buildings and recycling of metal debris and disposal of non recyclable material.

Project QC Manager, Time Critical Removal Action for the PCB Hot Spot Area Parcel E-2, 136027, US Navy, Hunters Point Shipyard, San Francisco, California, \$23,000,000.00, 01/2010 - Present

Pre-TCRA sampling

Screening removal and disposal of radiological contaminated material and soil.

Material potentially presenting an explosive hazard survey, screening and removal.

Excavation and removal of chemical and heavy metals contaminated soil and debris.

QA/QC H&S, Parcel E Groundwater Treatability Study, 133455, U.S. Navy, Hunters Point

Shipyard, San Francisco, California, \$1,500,000.00, 07/2009 - present

Installation of 20 Monitoring wells
Zero Vallance Iron (ZVI) injection at 90 direct push injection points.
Pre and Post injection vapor and groundwater sampling.

Accomplishments:
Perfect Safety record

07/2007 - 07/2009

Driver, Air Gas NCH, Vacaville, California

Provided delivery service by providing liquid and compressed gases and other supplies to customers.

02/2005 - 02/2007

Construction and Operations Manager, Call Henry, Sunnyvale, California

Provided construction and Operation management for Air Force facilities. Managed facility, utility and preventive maintenance programs. Managed a union workforce of 33 craftsmen of varied disciplines. Provide management for varied crafts for the maintenance of 400,000 square feet of mixed-use facilities including secure and unsecured areas, oversaw subcontracts, wrote statements of work for subcontract support, and tracked funding for maintenance and labor. Responsible for work schedule that covers three shifts, 7 days a week, and 365 days a year.

02/2001 - 02/2005

Quality Control Manager, IT Corporation (The Shaw Group Inc. acquired substantially all of the operating assets of The IT Group, Inc., on May 23, 2002), Concord, California

Provided Quality Control oversight for U.S. Navy Environmental Remediation and Construction Projects on EFA West Remedial Contract.

12/1994 - 02/2001

Environmental Field Technician, IT Corporation, Concord, California

Field Technician, Groundwater Treatment System Operator, and Site Construction Superintendent, Maintain and Constructed Groundwater treatment systems. Contract oversight for UST removal, Monitoring and Domestic well Installation and abandonment.

03/1990 - 12/1994

Environmental Compliance Specialist, U.S. Air Force, Travis AFB, California

Regulatory compliance specialist for hazardous waste disposal and analytical sampling. Responsible for all waste disposal documentation, analytical protocols, and waste classification. Managed the daily activities at two Part B permitted waste facilities.



PROFESSIONAL DEVELOPMENT SUPPORT CENTER
HUNTSVILLE, ALABAMA

CERTIFICATE

This is to certify that

DAVID PEET

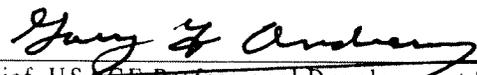
has completed the Corps of Engineers Training Course

CONSTRUCTION QUALITY MANAGEMENT FOR CONTRACTORS

Given at Sacramento, CA By Sacramento 9 & 10 NOV 2009
Location Instructional District Date
Expires: November 10, 2014
Verification (916) 557-7708

THIS CERTIFICATE EXPIRES FIVE YEARS FROM DATE OF ISSUE


Facilitator


Chief, USAACE Professional Development Support Center

Attachment 5
Outside Organizations

Outside Organizations

Organization Name/Address/Phone	Description of Services
<p>Curtis & Tompkins 2323 Fifth Street Berkeley, California 94710 510.486.0900</p> <p>Microseeps, Inc. University of Pittsburgh Applied Research Center 220 William Pitt Way Pittsburgh, Pennsylvania 15238 412.826.5245</p>	<p>Environmental Analytical Services</p>
<p>Subdynamic Locating Services, Inc. 3750 Charter Park Drive, Suite F San Jose, California 95136 408.723.4191</p>	<p>Subsurface Utility Locating Services</p>
<p>Hunter Surveying, Inc. P.O. Box 2455 Granite Bay, California 95746 916.988.5600</p>	<p>Land Surveying</p>
<p>Richard Brady & Associates 3710 Ruffin Road San Diego, California 92123 858.634.4507</p>	<p>SCAPS Testing</p>
<p>WDC Exploration & Wells 1961 Meeker Avenue Richmond, California 94804 510.236.6285</p>	<p>Monitoring Well Installation and Development</p>
<p>To Be Determined</p>	<p>Heavy Equipment Rental Services</p>
<p>Intrinsic Transportation, Inc. 3250A Dutton Avenue Santa Rosa, California 95407 707.578.0960</p>	<p>Waste Transport and Disposal Services</p>

***Attachment 6
Submittal Register***

Attachment 7
Testing Plan and Log

Attachment 8
Definable Features of Work Matrix

**DEFINABLE FEATURES OF WORK MATRIX
PROJECT QUALITY CONTROL PLAN
Supplemental Investigation, IR Site 28
Former Naval Station Moffett Field
Moffett Field, California**

Specification Section	Document Reference	Work Feature	Task Lead	Preparatory Meeting	Preparatory Inspection	Initial Inspection	Follow-up Inspection	Completion Inspection
<i>General Site Activities</i>								
4.2	Work Plan	Mobilization/Demobilization	Mark Vennemeyer	N/A	N/A	N/A	N/A	Mark Vennemeyer
4.3	Work Plan	Land surveying	Jim Teo	Jim Teo	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer
4.4 and 6.1	Work Plan	Subsurface Utility Clearance	Michael Glas	Michael Glas	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer
4.5	Work Plan	Traffic Control	Michael Glas	Michael Glas	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer
4.7	Work Plan	Waste Management	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer	Mark Vennemeyer
<i>Phase I</i>								
5.0	Work Plan	SCAPS Survey	Michael Glas	Michael Glas	Mark Vennemeyer	Michael Glas	Mark Vennemeyer	Mark Vennemeyer
<i>Phase II</i>								
6.2 and 6.3	Work Plan	Monitoring Well Drilling, Construction and Installation	Michael Glas	Michael Glas	Mark Vennemeyer	Michael Glas	Mark Vennemeyer	Mark Vennemeyer
6.4	Work Plan	Monitoring Well Development	Michael Glas	Michael Glas	Mark Vennemeyer	Michael Glas	Mark Vennemeyer	Mark Vennemeyer
6.2	Work Plan and SAP	Soil Sampling	Junn Masongsong	Junn Masongsong	Mark Vennemeyer	Junn Masongsong	Mark Vennemeyer	Mark Vennemeyer
7.0	Work Plan and SAP	Groundwater Sampling	Junn Masongsong	Junn Masongsong	Mark Vennemeyer	Junn Masongsong	Mark Vennemeyer	Mark Vennemeyer

Appendix C
Traffic Control Plan

FINAL
TRAFFIC CONTROL PLAN
Supplemental Investigation
Installation Restoration Site 28
Former Naval Air Station Moffett Field
Moffett Field, California

Contract Number: N62473-10-D-4009
Contract Task Order: 0046

Document Control Number: SHAW-4009-0046-0776.R1

June 2012

Submitted to:



Base Realignment and Closure
Program Management Office West Naval Facilities Engineering Command
1455 Frazee Road, Suite 900
San Diego, California 92108

Submitted by:



4005 Port Chicago Highway
Concord, California 94520-1120

FINAL
TRAFFIC CONTROL PLAN
Supplemental Investigation
Installation Restoration Site 28
Former Naval Air Station Moffett Field
Moffett Field, California

Contract Number: N62473-10-D-4009
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Document Control Number: SHAW-4009-0046-0776.R1

June 2012

Approved by: 
Neil Hey, California PG No. 8006
Project Manager

Date: June 27, 2012

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3.0 Closure to Through Traffic on Cummins Avenue and Cody Road 3-1

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- Figure C-2 Closure of Cummins Avenue, West of the Traffic Island (Typical)
- Figure C-3 Closure of Cummins Ave/Cody Road, East of Traffic Island (Typical)
- Figure C-4 Wescoat Road South of Traffic Island Lane Closure (Typical)

1.0 Introduction

This Traffic Control Plan was prepared to describe traffic control measures that will be implemented during the Supplemental Investigation at Installation Restoration Site 28, former Naval Air Station Moffett Field, California. The study requires truck-mounted equipment that will be set up, operated, and removed on a daily basis. Due to the fact that several borings need to be drilled either near roadways or in roadways, parts of Wescoat Road, Cummins Avenue, and Cody Road will need to be either temporarily reduced to one lane or fully closed during the daytime. The traffic control measures are described in the following sections.

Prior to implementing this plan, it shall be submitted to and approved by National Aeronautics and Space Administration Security and Fire Department. All road/lane closures shall be coordinated with National Aeronautics and Space Administration Security and Fire Department.

2.0 *Wescoat Road Reduced to One Lane*

Field activities associated with the Former Building 88 Area, Site Characterization and Analysis Penetrometer System testing, and possibly monitoring well installation will require temporary lane closures on Wescoat Road, between Dugan Avenue and Severyns Avenue. Based on the field work locations (Figure C-1) the lane closures will alternate between both sides of Wescoat Road. The temporary lane closures will be sequenced such that only one lane in either direction will be closed at a given point in time. During the temporary lane closures traffic will be reduced to one lane of travel. When it is possible for traffic to safely travel adjacent to the work area on Wescoat Road signs, indicating roadwork ahead and lane closure ahead, will be placed at the eastern and western approaches to the work area on Wescoat Road or at the southern approaches of Cody Road, pending location of work. Traffic cones, signage, and flagger(s) will be used to direct traffic around the work area (see Figure C-1 for planned signage, cones, and flagger locations).

Any closure(s) will be removed upon completion of the work or the end of the work day. No overnight closures are anticipated.

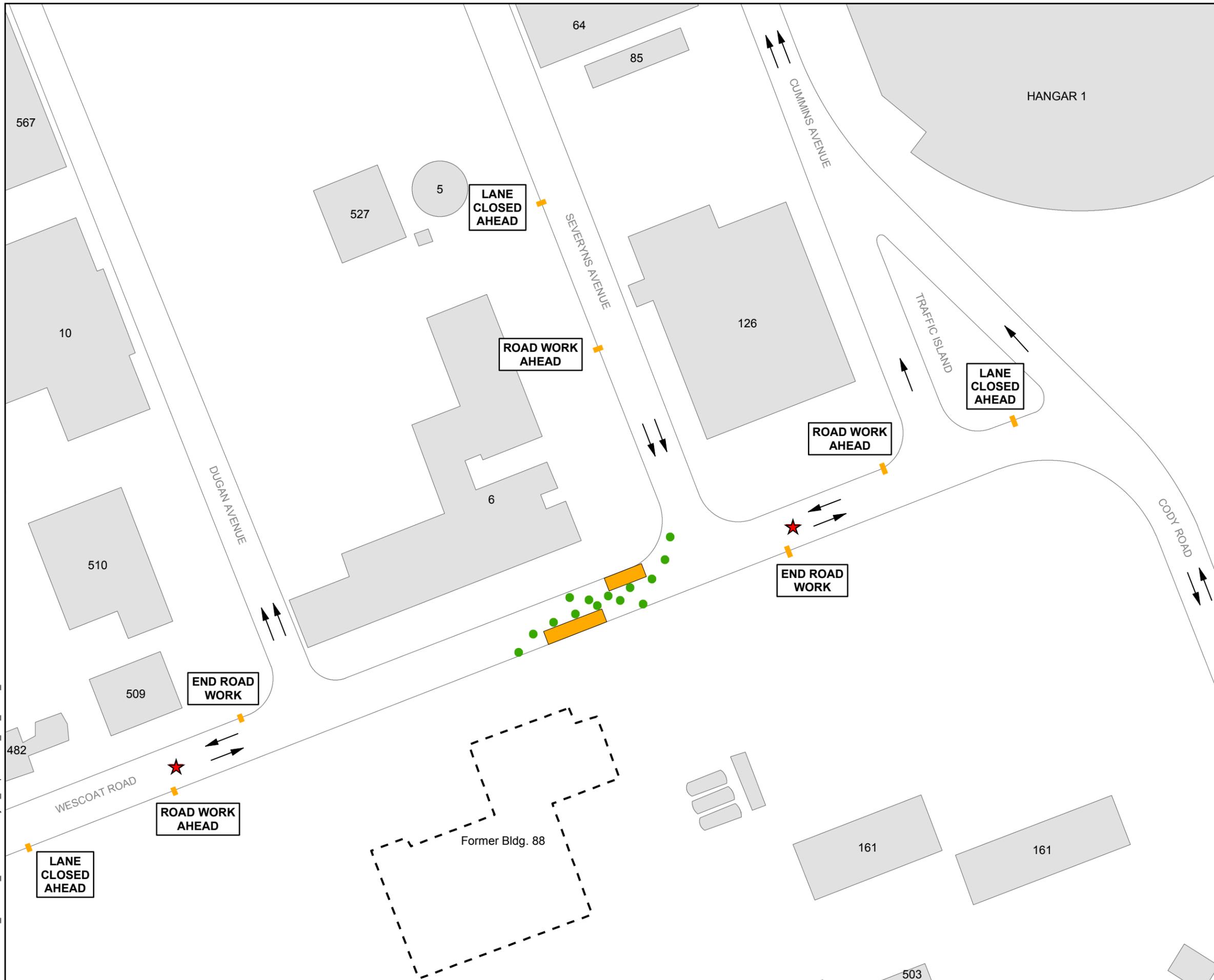
3.0 Closure to Through Traffic on Cummins Avenue and Cody Road

Field activities associated with the Traffic Island Area, Site Characterization and Analysis Penetrometer System testing, and possibly monitoring well installation will require closing sections of Cummins Avenue and Cody Road, as well as closing one lane along Wescoat Road between Cummins Avenue and Cody Road. The road and lane closures are based on the planned field work locations presented on Figures C-2 through C-4. Both the road and lane closures will be temporary. Signage indicating the closures will be placed on the southern approach for Cody Road, the western approach for Wescoat Road, and the northern approach of Severyns Avenue. Barricades and traffic cones will be placed at the entrance of both roads to prevent vehicles from entering (see Figures C-2 and C-3 for typical signage locations). Traffic cones, signage, and flagger(s) will be used to close one lane of Wescoat Road and control traffic (see Figure C-4 for planned signage, cones, and flagger locations).

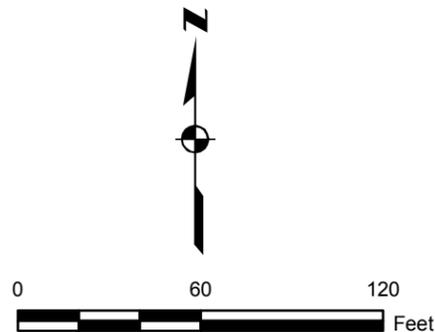
All closures will be removed upon completion of the work or at the end of the day. No overnight closures are anticipated.

Figures

C:\GIS\Moffett_NAS\GIS_Documents\Project_Maps\Moffett_096_Traffic_Wescoat.mxd Karen.Black 01/31/12



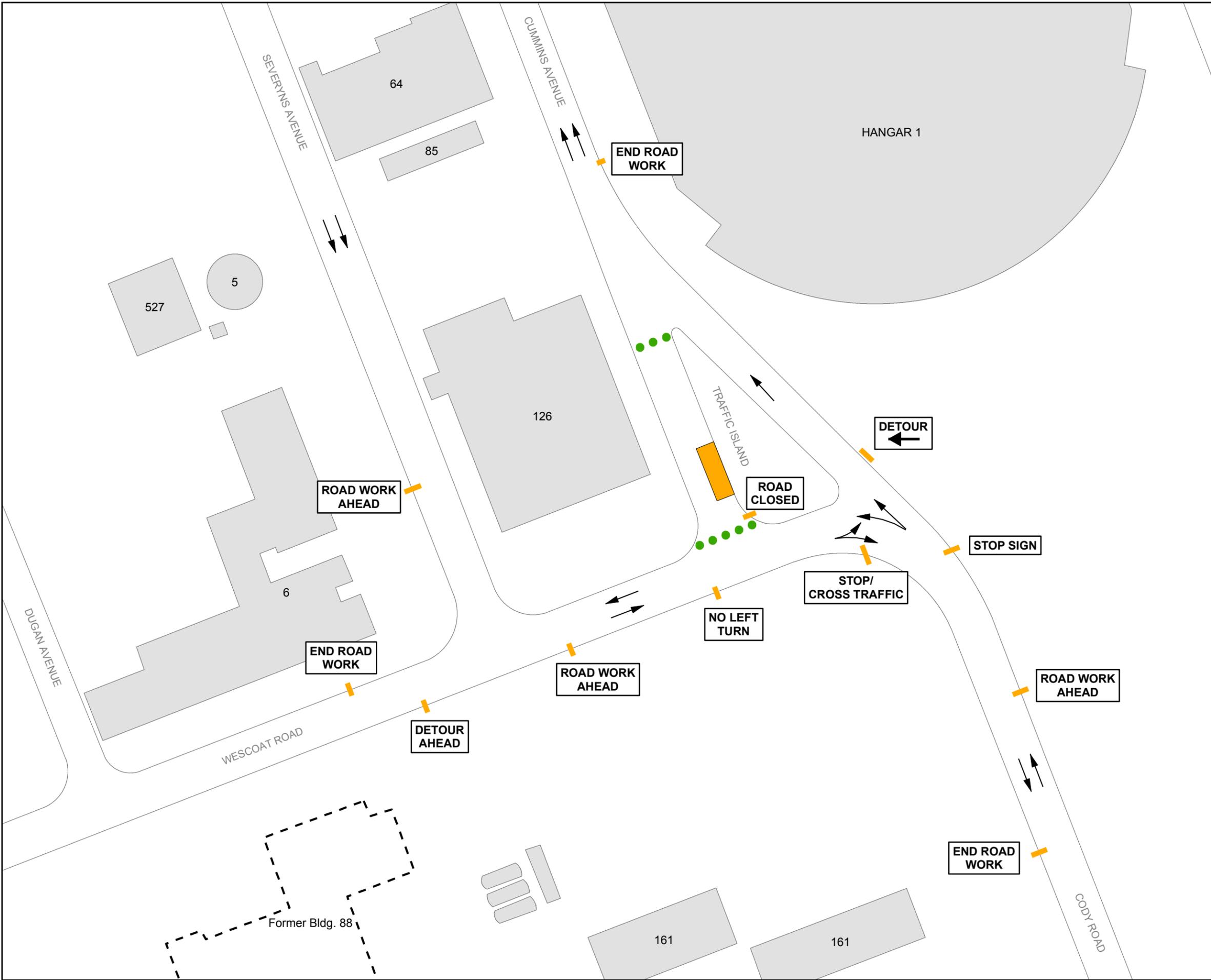
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-  WORK AREA
 -  SIGN
 -  CONES
 -  FLAGGER
 -  TRAFFIC DIRECTION
 -  503 BUILDING AND BUILDING NUMBER



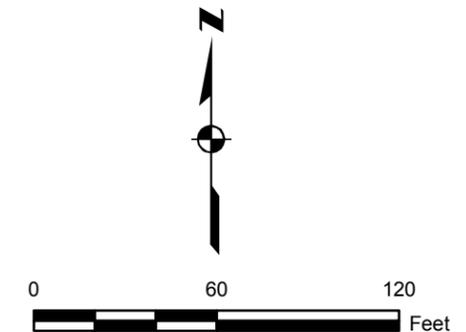
 BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST
 NAVAL FACILITIES ENGINEERING COMMAND
 SAN DIEGO, CALIFORNIA

FIGURE C-1
WESCOAT ROAD:
ALTERNATING LANE CLOSURES
 IR SITE 28, FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

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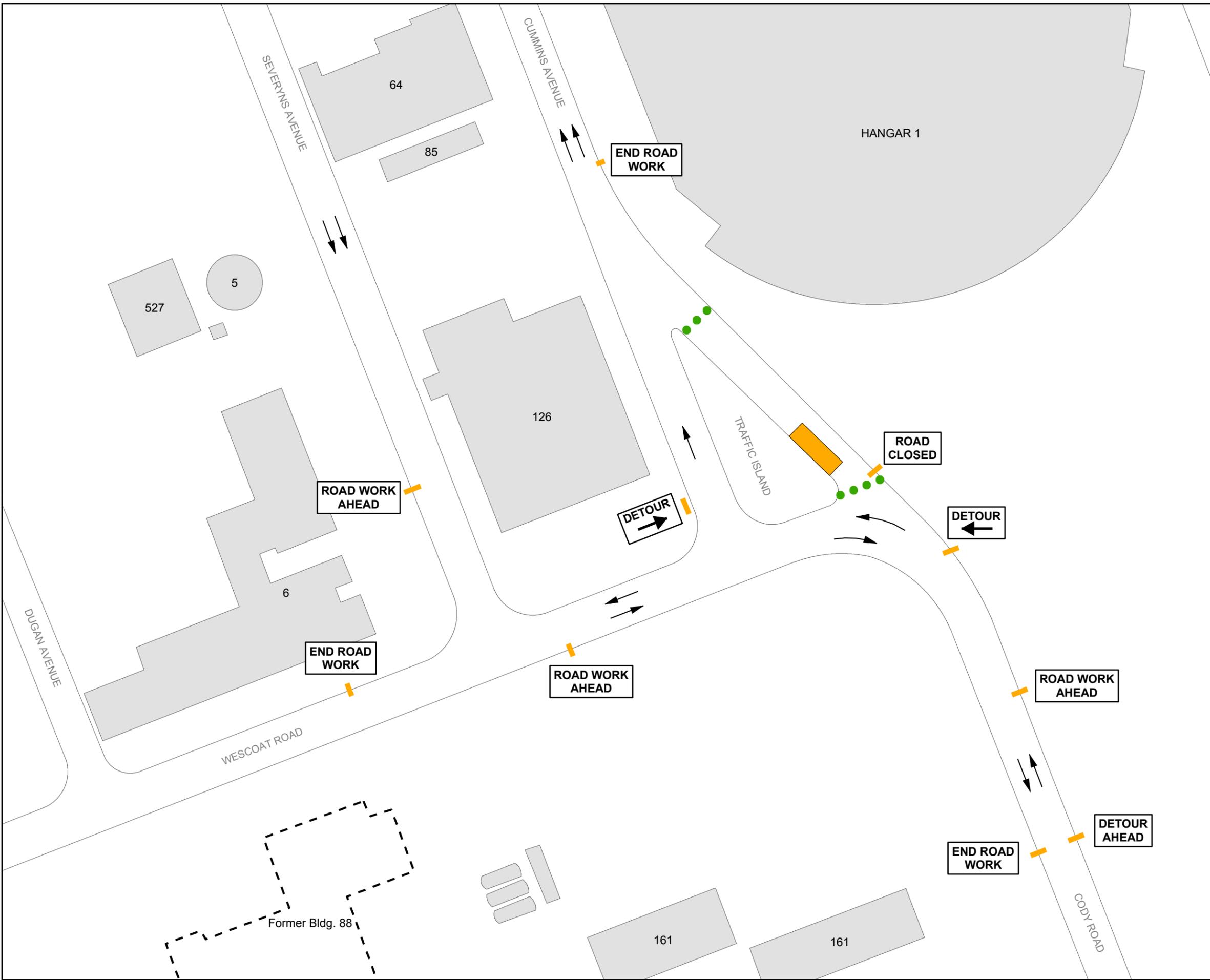
- Legend**
-  WORK AREA
 -  SIGN
 -  CONES/BARRICADE
 -  TRAFFIC DIRECTION
 -  503 BUILDING AND BUILDING NUMBER



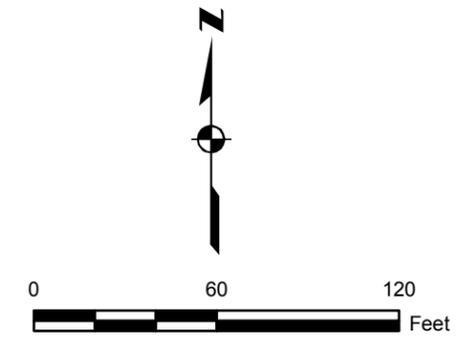
 BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
NAVAL FACILITIES
ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

FIGURE C-2
CLOSURE OF CUMMINS AVENUE
WEST OF TRAFFIC ISLAND (TYPICAL)
IR SITE 28, FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

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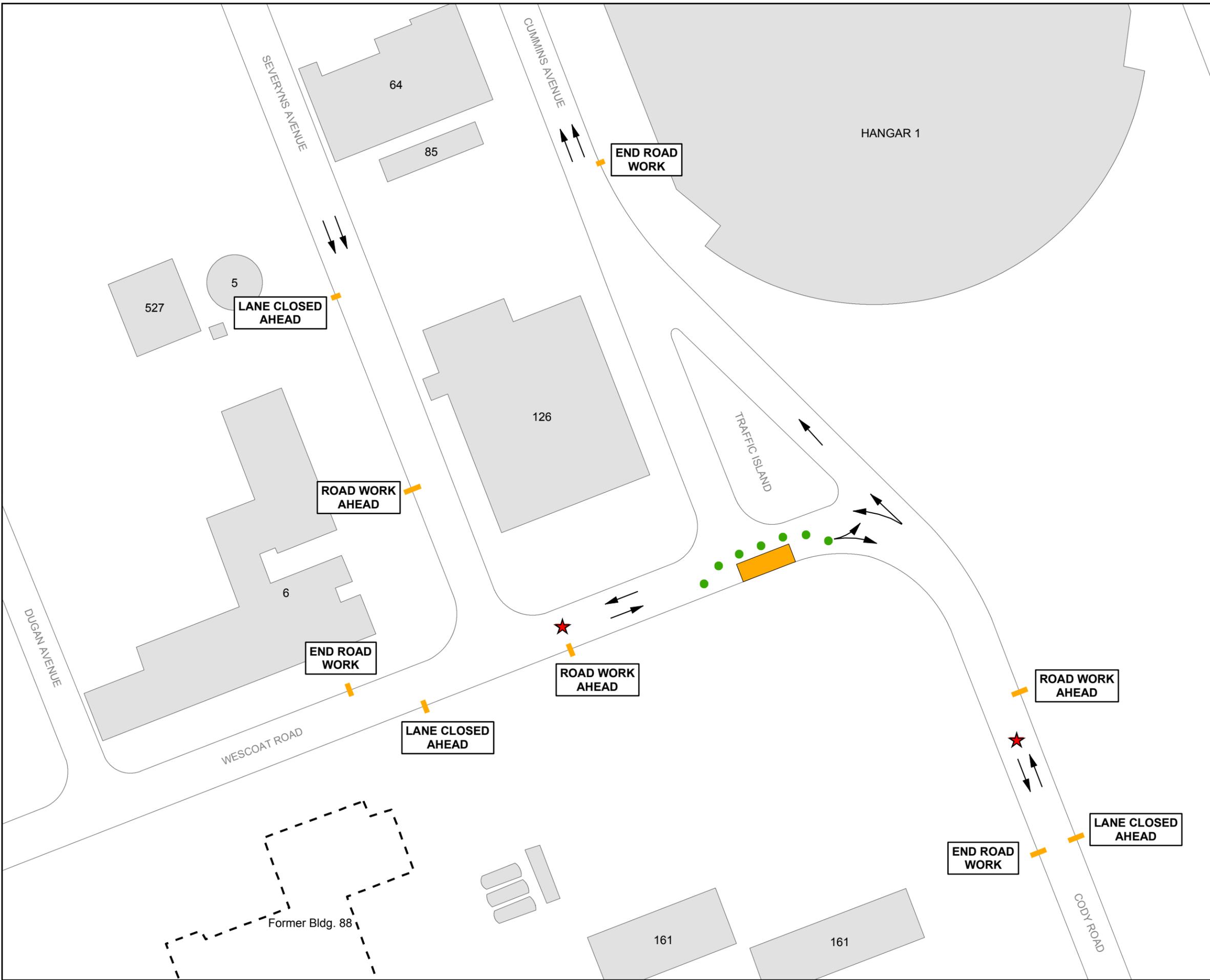
- Legend**
- WORK AREA
 - SIGN
 - CONES/BARRICADE
 - TRAFFIC DIRECTION
 - 503 BUILDING AND BUILDING NUMBER



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
NAVAL FACILITIES
ENGINEERING COMMAND
SAN DIEGO, CALIFORNIA

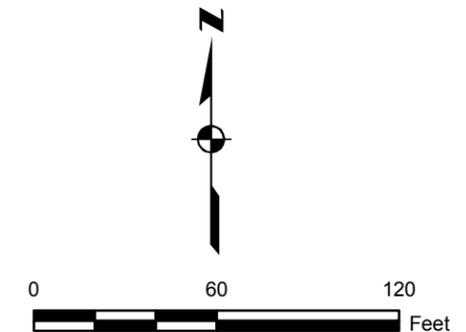
FIGURE C-3
CLOSURE AT CUMMINS AVE/CODY ROAD
EAST OF TRAFFIC ISLAND (TYPICAL)
IR SITE 28, FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

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Legend

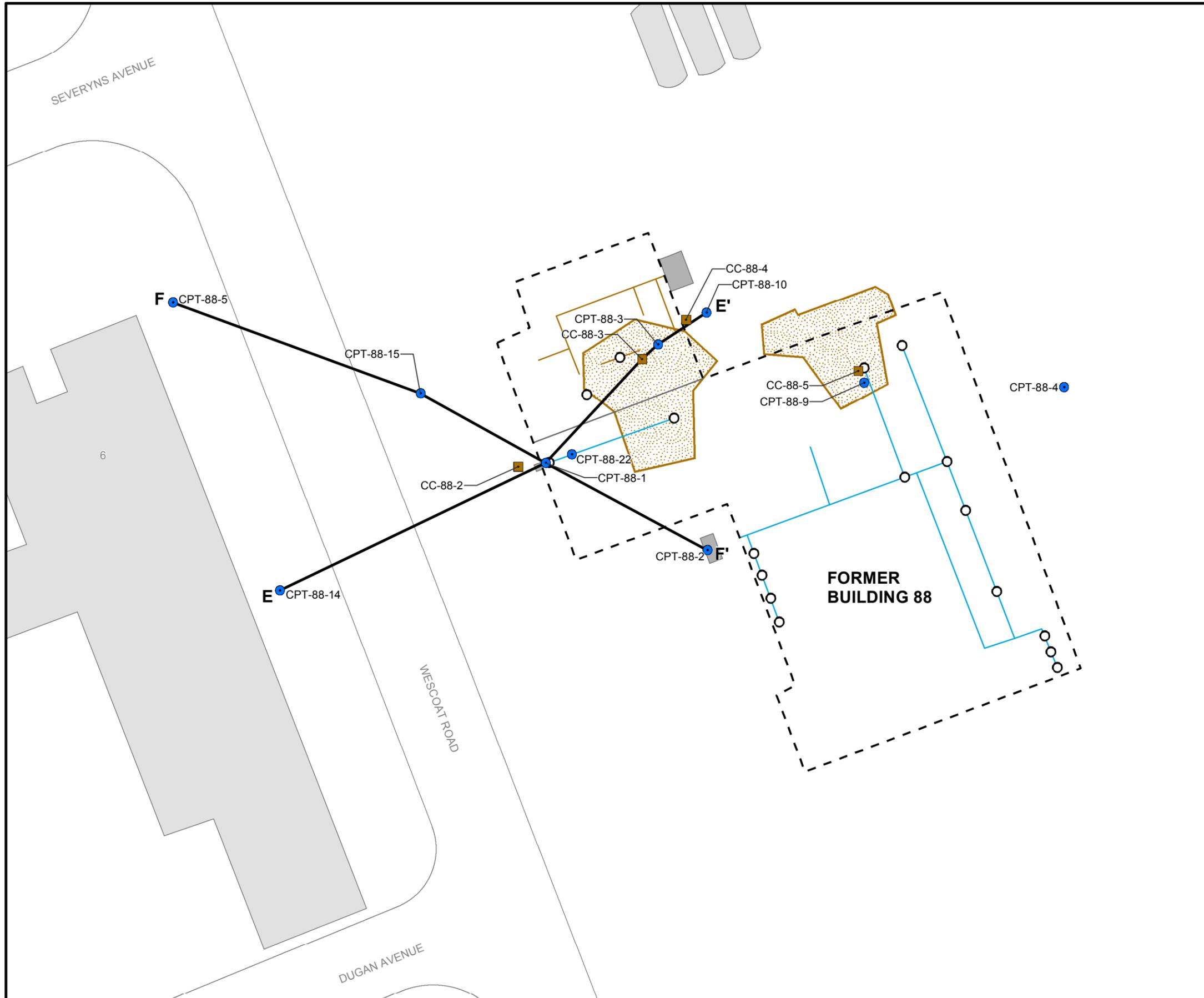
-  WORK AREA
-  SIGN
-  CONES
-  FLAGGER
-  TRAFFIC DIRECTION
-  503 BUILDING AND BUILDING NUMBER



	BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST NAVAL FACILITIES ENGINEERING COMMAND SAN DIEGO, CALIFORNIA
---	--

FIGURE C-4
WESCOAT ROAD SOUTH OF
TRAFFIC ISLAND LANE CLOSURE (TYPICAL)
 IR SITE 28, FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

Appendix D
Select Drawings from Previous Reports
(provided on electronic copy only)



LEGEND

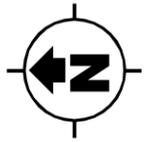
- CPT-88-15 ● CPT/DPT LOCATION
- CC-88-5 ■ CONTINUOUS CORE BORING
- FLOOR DRAIN (REMOVED)
- E—E' GEOLOGIC CROSS SECTION LOCATION
- ⚡ FLOOR DRAIN PIPING (REMOVED)
- ⚡ WASTEWATER COLLECTION TRENCH (REMOVED)
- 126 BUILDING AND BUILDING NUMBER
- SUMP OR TANK (REMOVED)
- ▨ REMEDIAL EXCAVATION AREAS

NOTES:

- CC - CONTINUOUS CORE
- CPT - CONE PENETROMETER TESTING
- DPT - DIRECT PUSH TECHNOLOGY
- NAS - NAVAL AIR STATION



Scale: 1" = 30'



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA

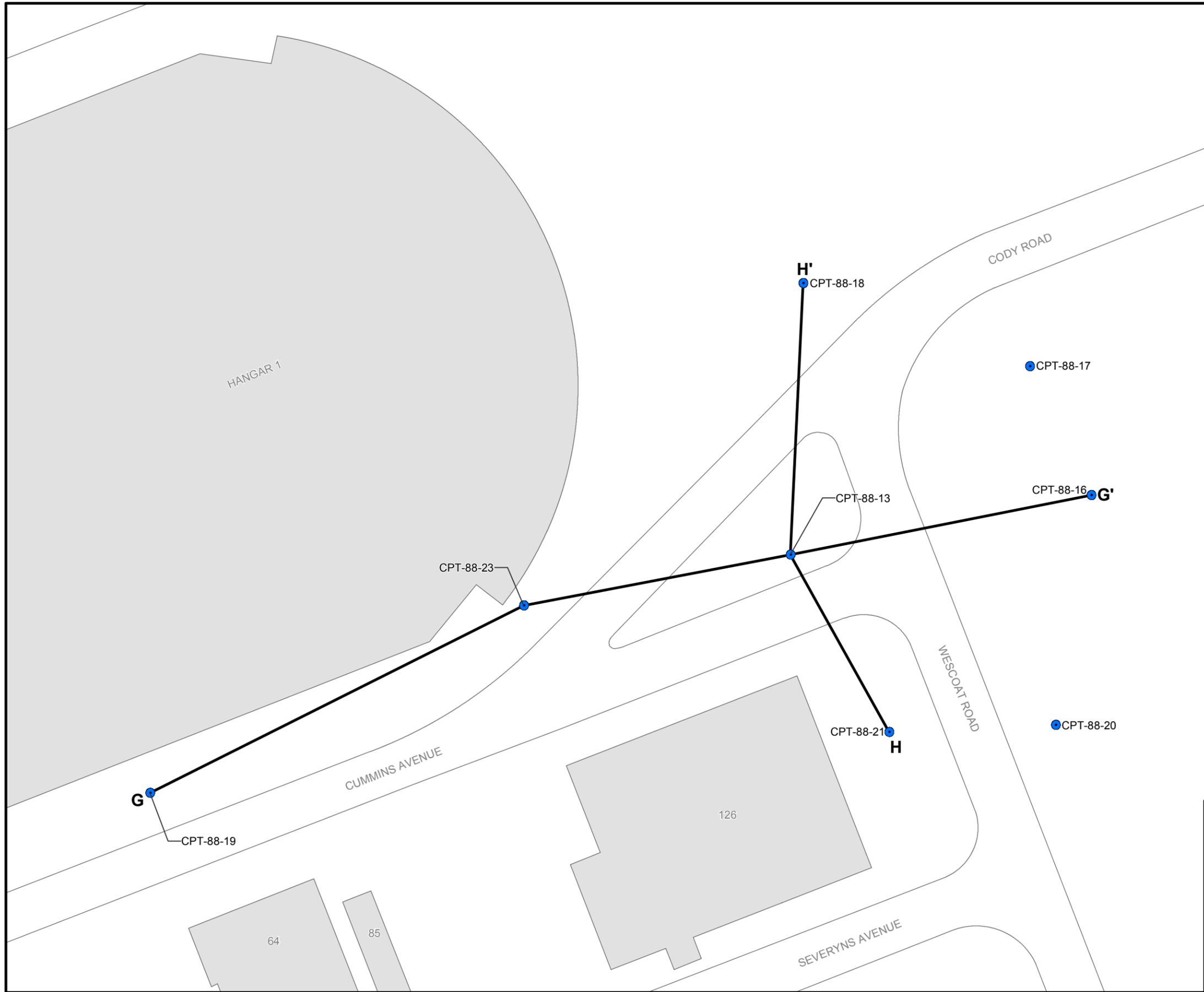
FINAL FORMER BUILDING 88 INVESTIGATION REPORT

FIGURE 9-2

FORMER BUILDING 88 AREA
CROSS SECTION LOCATION MAP
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

REVISION: 0
AUTHOR: GFG
DCN: ECSD-2201-0017-0003
FILE NUMBER: 080083L2066.mxd





LEGEND

- CPT-88-23 ● CPT/DPT LOCATION
- G—G' GEOLOGIC CROSS SECTION LOCATION
- 126 BUILDING AND BUILDING NUMBER

NOTES:

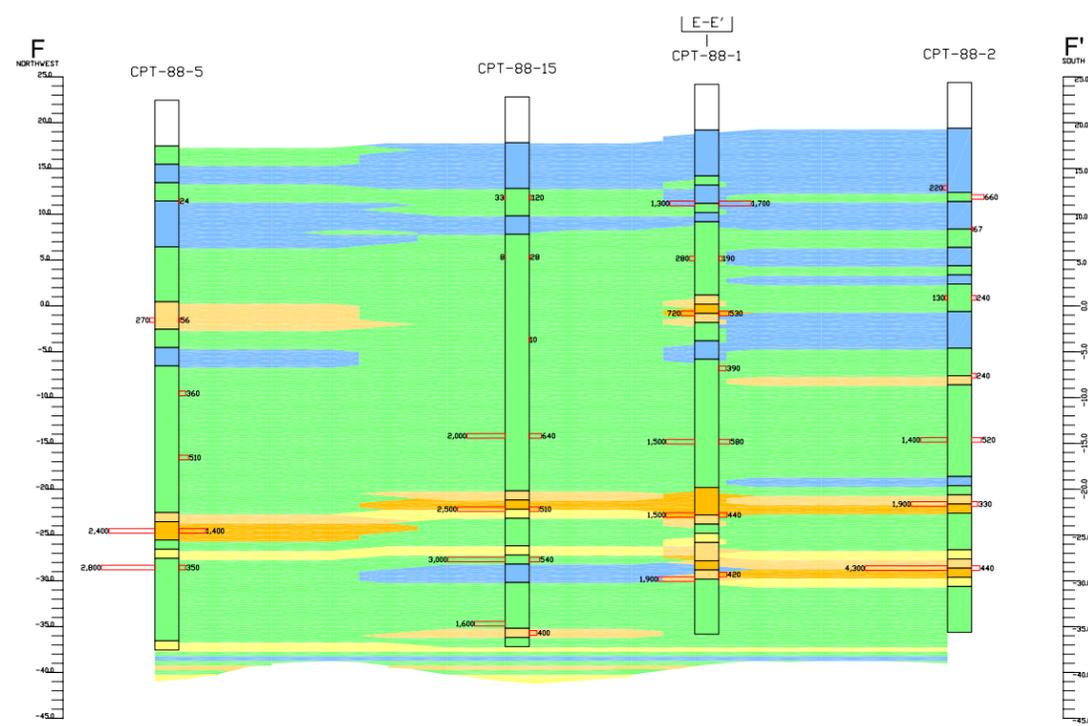
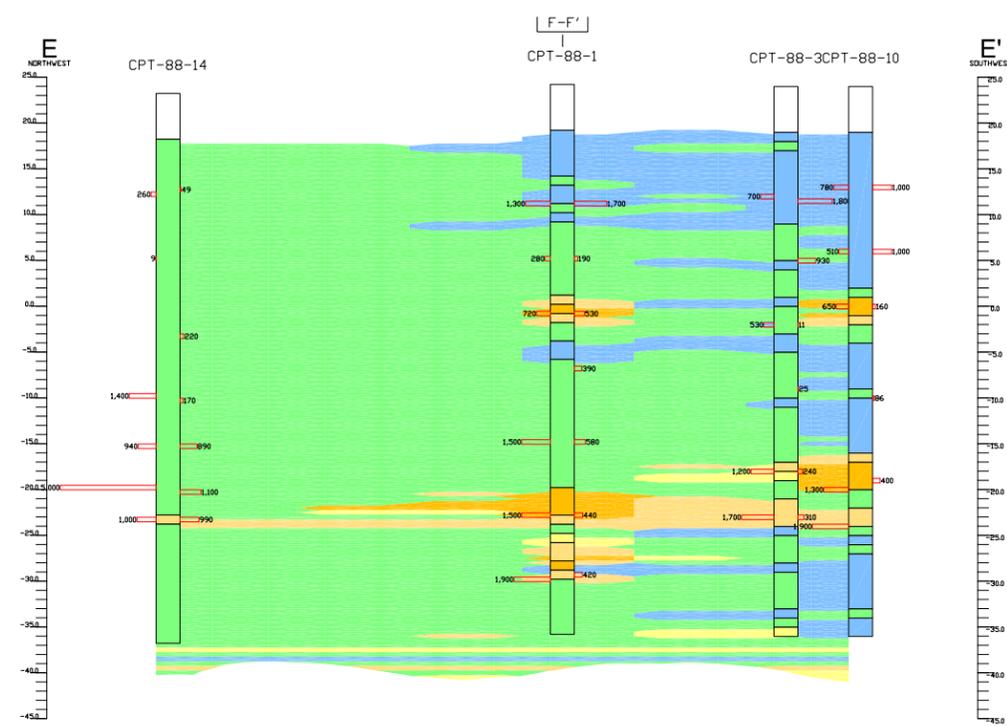
- CPT - CONE PENETROMETER TESTING
- DPT - DIRECT PUSH TECHNOLOGY
- NAS - NAVAL AIR STATION



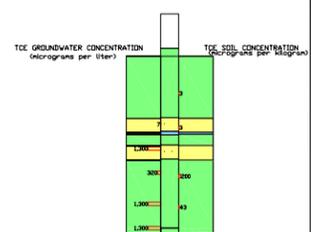
Scale: 1" = 50'



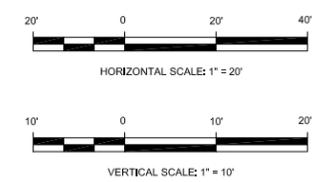
<p>BASE REALIGNMENT AND CLOSURE PROGRAM MANAGEMENT OFFICE WEST SAN DIEGO, CALIFORNIA</p>	
<p>FINAL FORMER BUILDING 88 INVESTIGATION REPORT</p>	
<p>FIGURE 9-3</p>	
<p>TRAFFIC ISLAND AREA CROSS SECTION LOCATION MAP FORMER NAS MOFFETT FIELD MOFFETT FIELD, CALIFORNIA</p>	
<p>REVISION: 0 AUTHOR: GFG DCN: ECSD-2201-0017-0003 FILE NUMBER: 080083L2067.mxd</p>	<p>TETRA TECH EC, INC.</p>



- LEGEND**
- INTERVAL NOT LOGGED
 - CL CLAY, SILTY CLAY
 - GP/IGM GRAVEL WITH SAND & SILT
 - ML SILT, CLAYEY SILT, SANDY SILT
 - SM SILTY SAND
 - SP SAND
 - TCE TRICHOETHENE
 - INTERSECTING CROSS SECTION
 - TCE CONCENTRATION
 - START OF W88-1 LITHOLOGY LOGGED DURING WELL INSTALLATION



NOTE: CROSS SECTIONS REPRESENT VERTICAL SLICES THROUGH 3-DIMENSIONAL SOLID MODEL GENERATED IN ROCKWORKS. LITHOLOGIES NOT ANCHORED BY CPT LOCATIONS REPRESENT LITHOLOGY PROJECTED INTO PLANE OF CROSS SECTION FROM OUTSIDE PLANE OF VIEW.

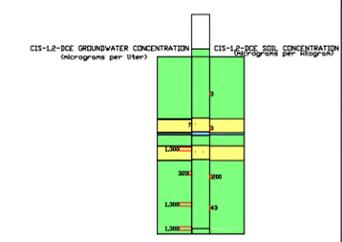
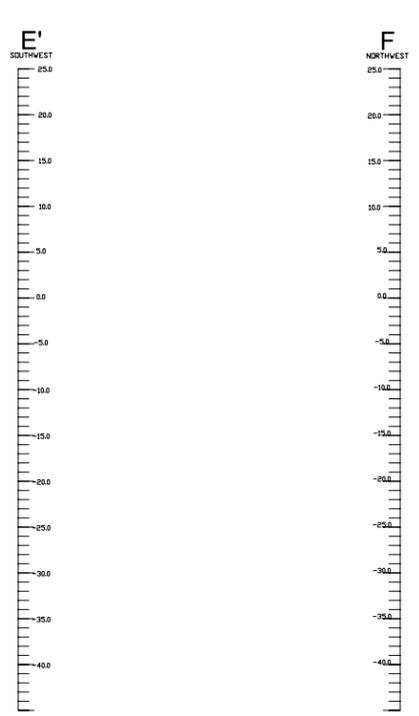
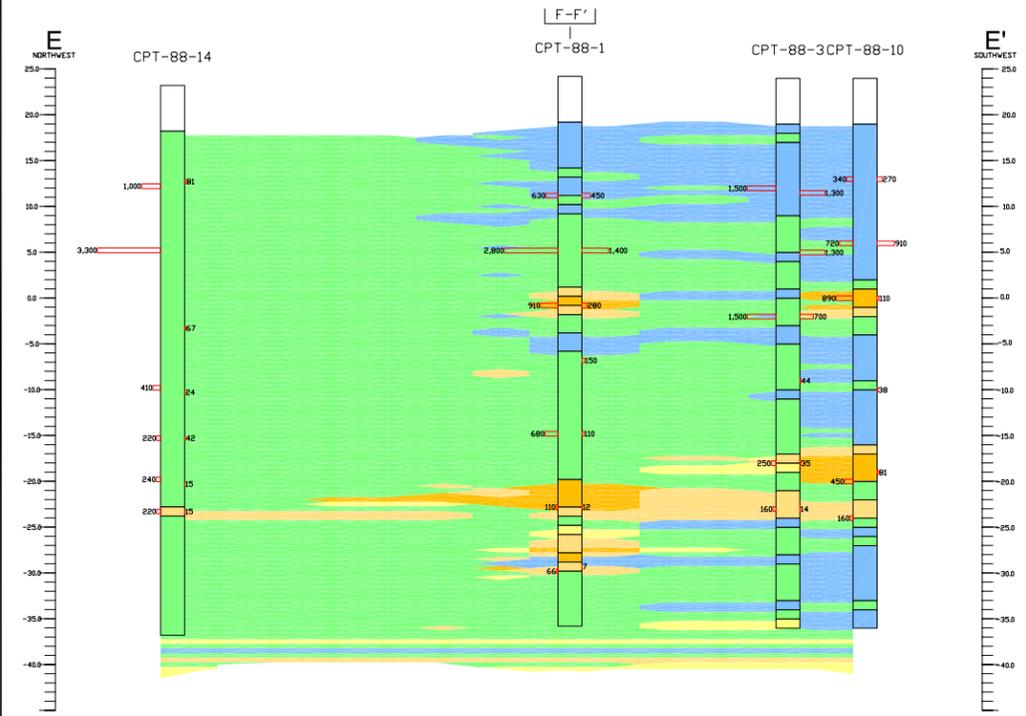


**BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CA**
**FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-2
 GENERALIZED CROSS SECTIONS E-E' AND F-F'
 SHOWING TCE SOIL AND GROUNDWATER CONCENTRATIONS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CA**

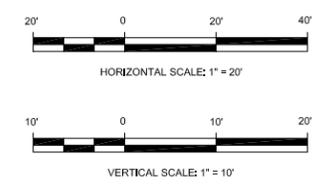
REVISION: 0
 AUTHOR: KLD
 FILE : PLATE9-1.DWG



- LEGEND**
- INTERVAL NOT LOGGED
 - CL CLAY, SILTY CLAY
 - GP/IGM GRAVEL WITH SAND & SILT
 - ML SILT, CLAYEY SILT, SANDY SILT
 - SM SILTY SAND
 - SP SAND
 - CIS-1,2-DCE CIS-1,2-DICHLOROETHENE
 - [F-F'] INTERSECTING CROSS SECTION
 - CIS-1,2-DCE CONCENTRATION
 - START OF W88-1 LITHOLOGY LOGGED DURING WELL INSTALLATION



NOTE: CROSS SECTIONS REPRESENT VERTICAL SLICES THROUGH 3-DIMENSIONAL SOLID MODEL GENERATED IN ROCKWORKS. LITHOLOGIES NOT ANCHORED BY CPT LOCATIONS REPRESENT LITHOLOGY PROJECTED INTO PLANE OF CROSS SECTION FROM OUTSIDE PLANE OF VIEW.

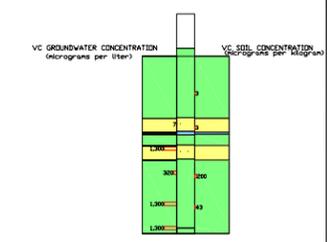
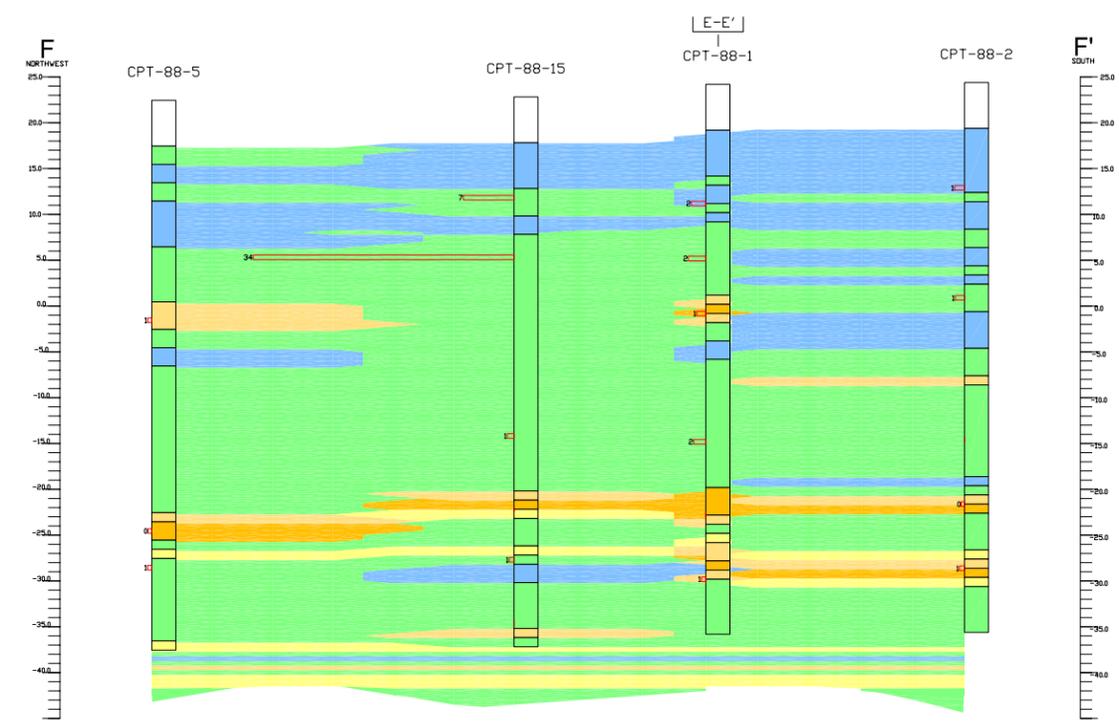
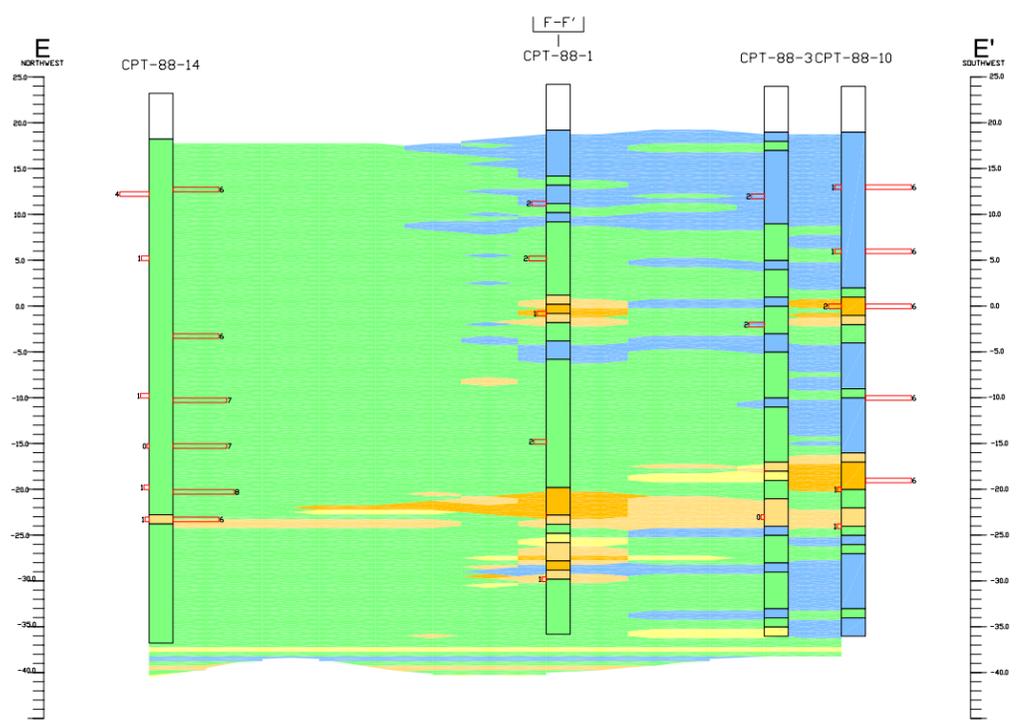


BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA
FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-3
GENERALIZED CROSS SECTIONS E-E' AND F-F'
SHOWING CIS-1,2-DCE SOIL AND GROUNDWATER CONCENTRATIONS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

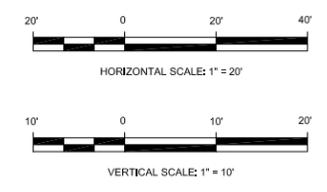
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 AUTHOR: KLD
 FILE : PLATE9-3.DWG



- LEGEND**
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 - GP/IGM GRAVEL WITH SAND & SILT
 - ML SILT, CLAYEY SILT, SANDY SILT
 - SM SILTY SAND
 - SP SAND
 - VC VINYL CHLORIDE
 - INTERSECTING CROSS SECTION
 - VC CONCENTRATION
 - START OF W88-1 LITHOLOGY LOGGED DURING WELL INSTALLATION



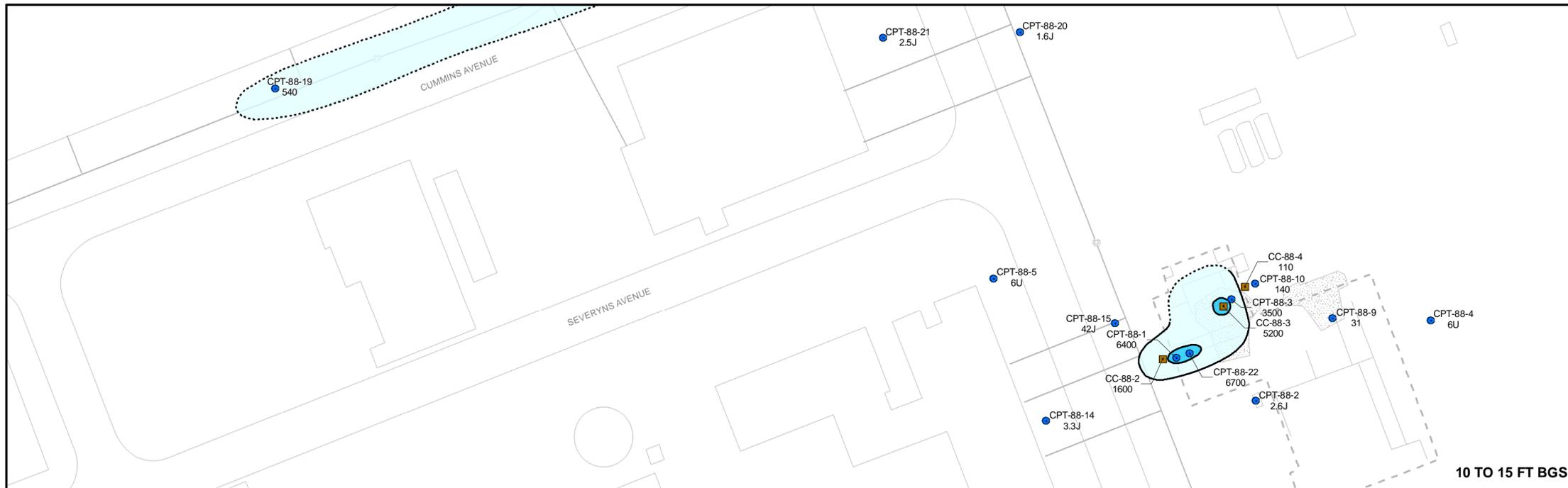
NOTE: CROSS SECTIONS REPRESENT VERTICAL SLICES THROUGH 3-DIMENSIONAL SOLID MODEL GENERATED IN ROCKWORKS. LITHOLOGIES NOT ANCHORED BY CPT LOCATIONS REPRESENT LITHOLOGY PROJECTED INTO PLANE OF CROSS SECTION FROM OUTSIDE PLANE OF VIEW.



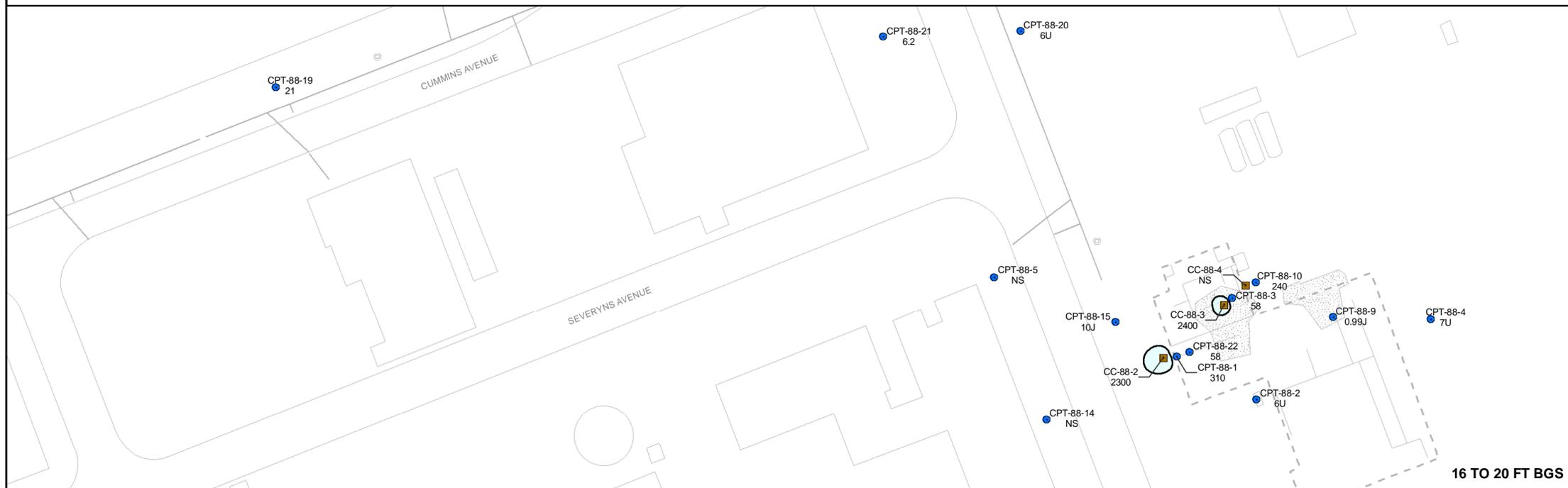
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA
FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-4
GENERALIZED CROSS SECTIONS E-E' AND F-F'
SHOWING VC SOIL AND GROUNDWATER CONCENTRATIONS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

REVISION: 0
 AUTHOR: KLD
 FILE : PLATE9-4.DWG

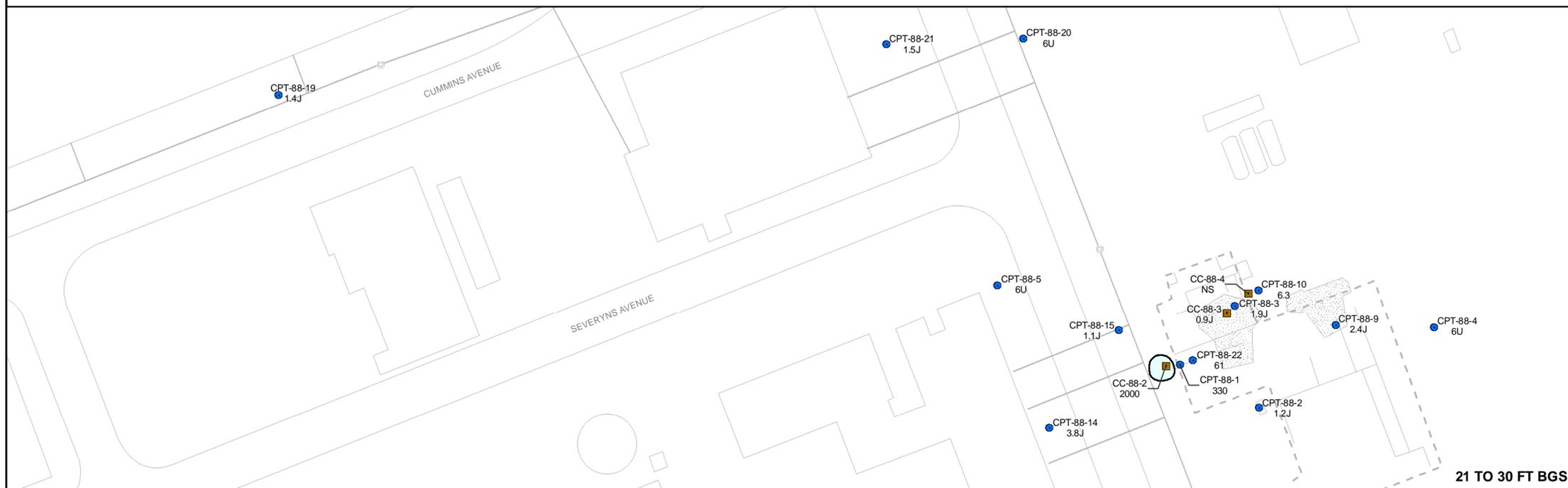




10 TO 15 FT BGS



16 TO 20 FT BGS



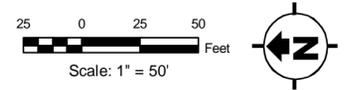
21 TO 30 FT BGS

LEGEND

- CPT-88-15 42J ● CPT/DPT LOCATION
- 42J ● PCE CONCENTRATION µg/kg
- CC-88-4 110 ■ CONTINUOUS CORE BORING
- 110 ■ PCE CONCENTRATION µg/kg
- 480 - 5000 µg/kg PCE DASHED WHERE INFERRED
- > 5000 µg/kg PCE

NOTES:

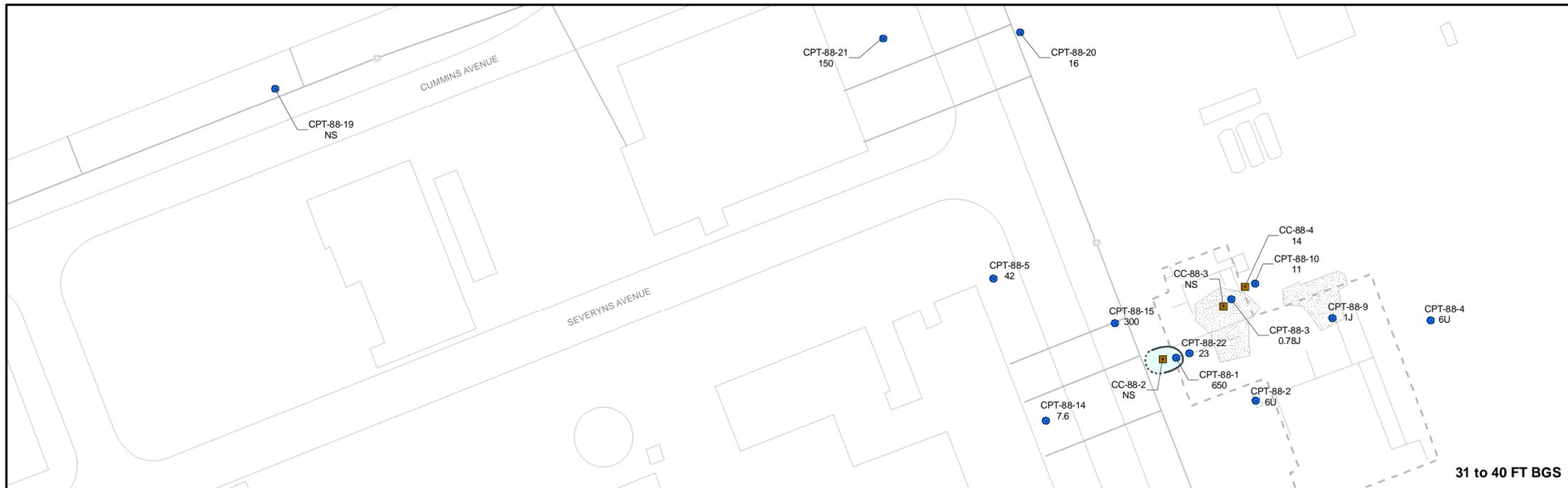
- µg/kg - MICROGRAMS PER KILOGRAM
- BGS - BELOW GROUND SURFACE
- CPT - CONE PENETROMETER TESTING
- FT - FEET
- J - ESTIMATED VALUE
- NAS - NAVAL AIR STATION
- NS - NOT SAMPLED
- PCE - TETRACHLOROETHENE
- U - NOT DETECTED AT LABORATORY REPORTING LIMIT



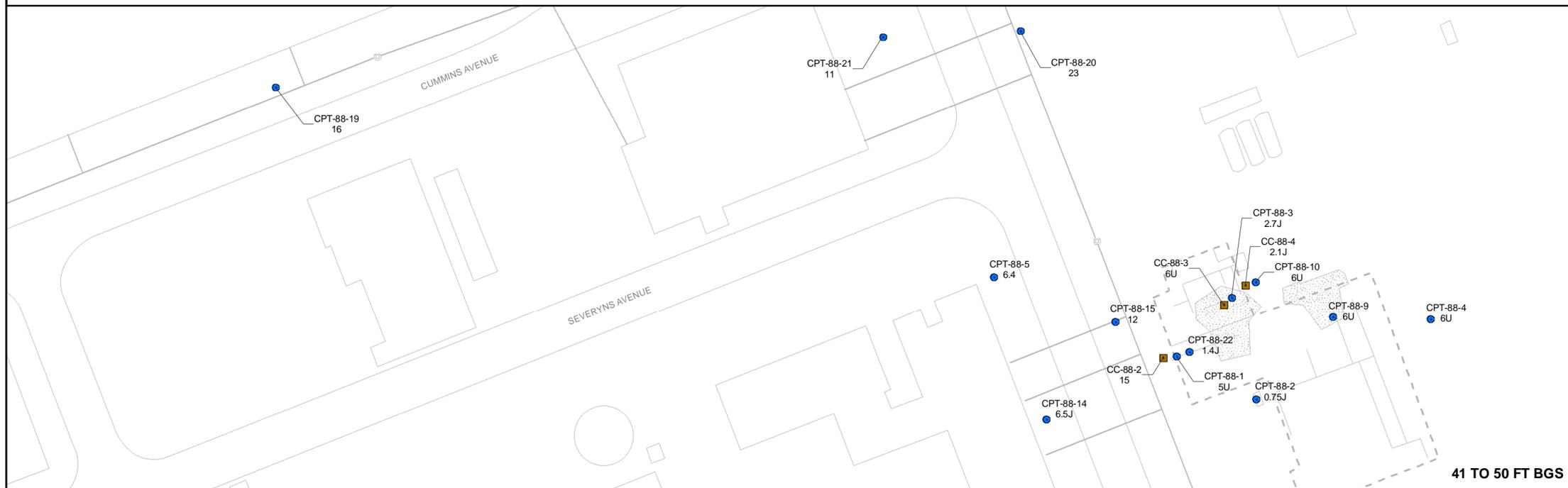
BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CALIFORNIA

FINAL FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-5
 FORMER BUILDING 88 AREA SOIL PCE ISOCONCENTRATIONS
 10 - 30 FEET BGS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

REVISION: 1
 AUTHOR: CS
 DCN: E0360-2201-0017-0003
 FILE NUMBER: 0809832070.mxd



31 to 40 FT BGS

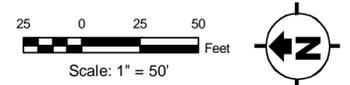


41 TO 50 FT BGS



51 TO 60 FT BGS

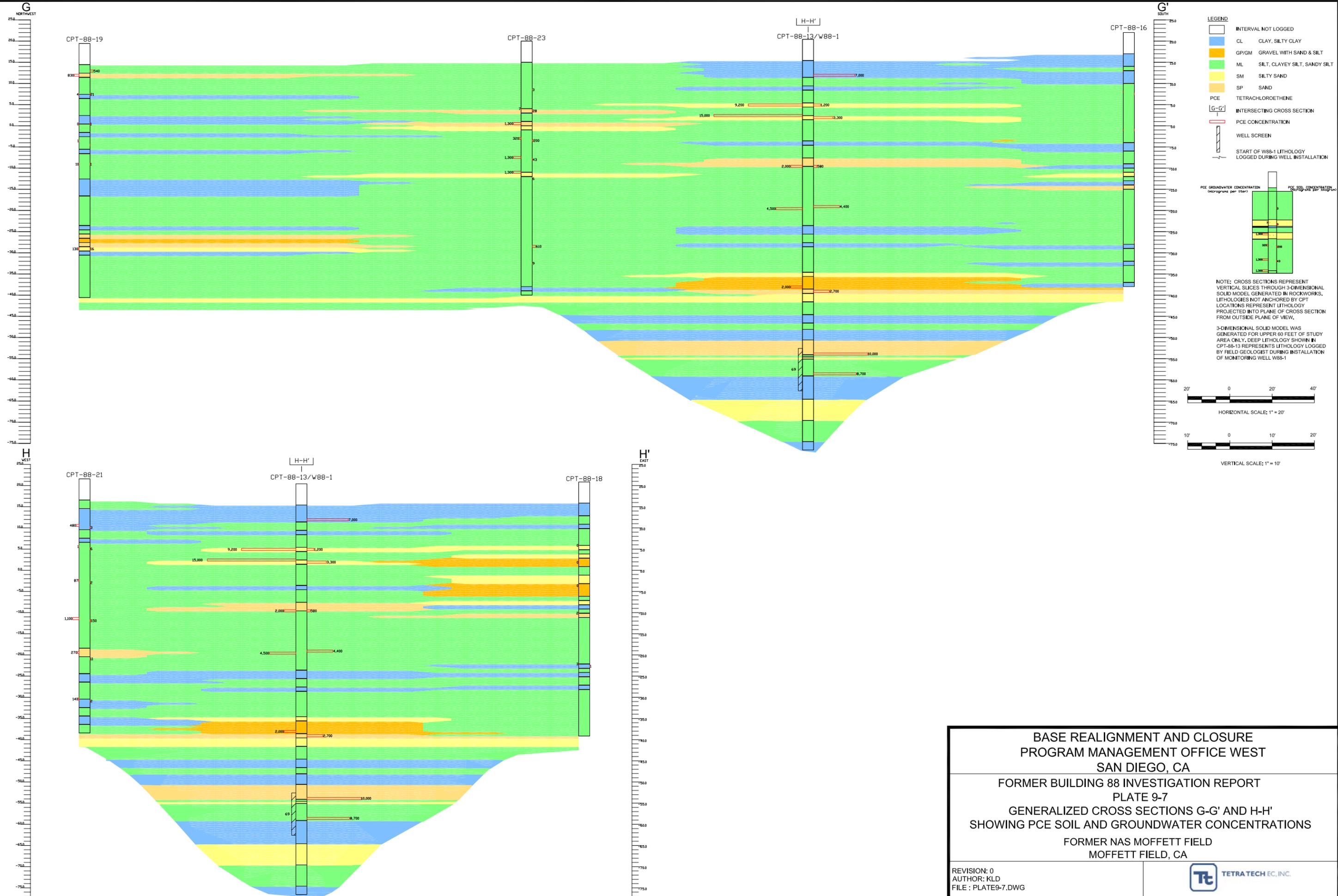
- LEGEND**
- CPT-88-15 42J CPT/DPT LOCATION
 - 42J PCE CONCENTRATION µg/kg
 - CC-88-4 110 CONTINUOUS CORE BORING
 - 110 PCE CONCENTRATION µg/kg
 - 480 - 5000 µg/kg PCE DASHED WHERE INFERRED
- NOTES:**
- µg/kg - MICROGRAMS PER KILOGRAM
 - BGS - BELOW GROUND SURFACE
 - CPT - CONE PENETROMETER TESTING
 - FT - FEET
 - J - ESTIMATED VALUE
 - NAS - NAVAL AIR STATION
 - NS - NOT SAMPLED
 - PCE - TETRACHLOROETHENE
 - U - NOT DETECTED AT LABORATORY REPORTING LIMIT



BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CALIFORNIA
 FINAL FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-6
 FORMER BUILDING 88 AREA SOIL PCE
 ISOCONCENTRATIONS 31 - 60 FEET BGS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

REVISION: 1
 AUTHOR: RKH
 DCN: ECSD-2201-0017-0003
 FILE NUMBER: 080983C2071.mxd

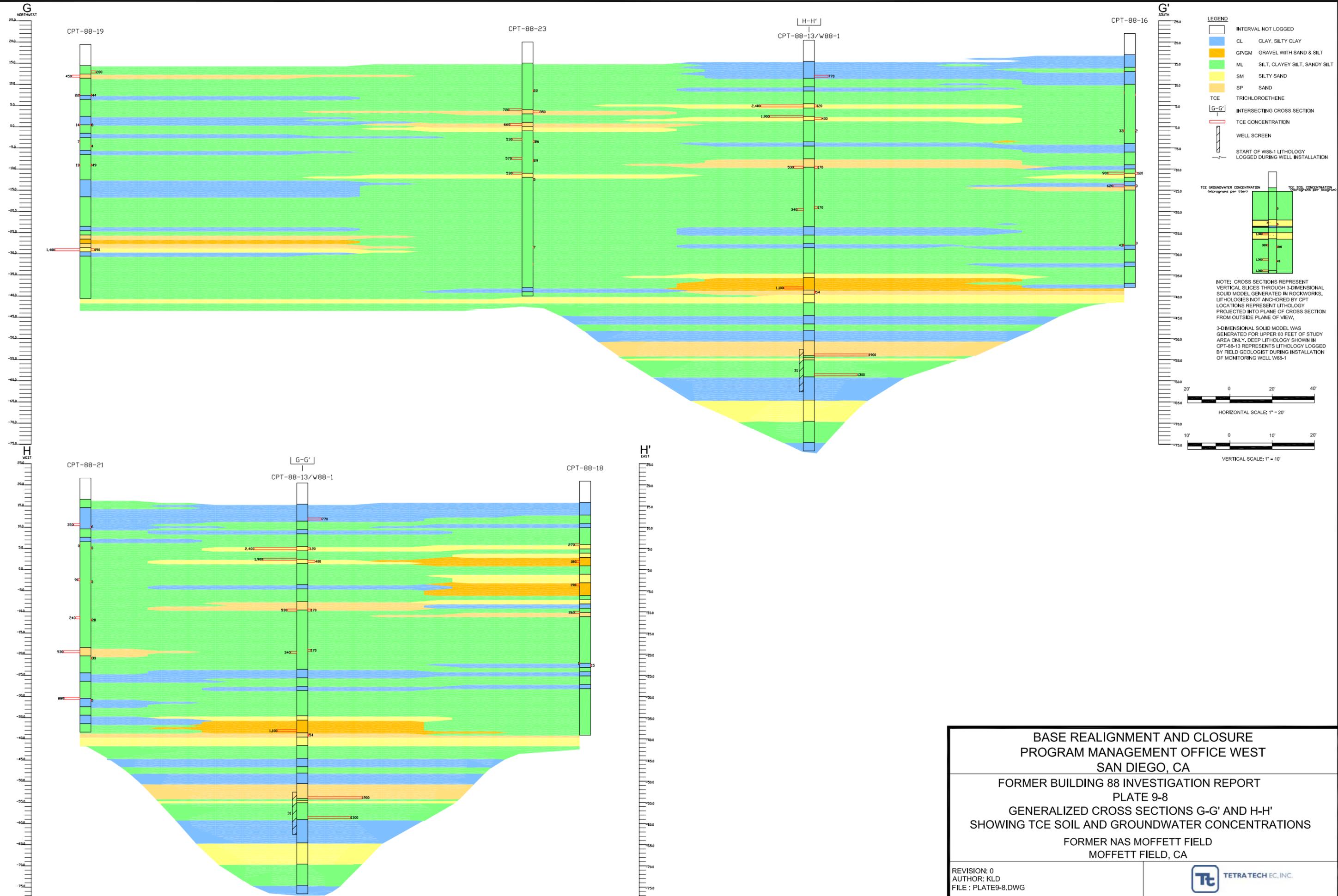




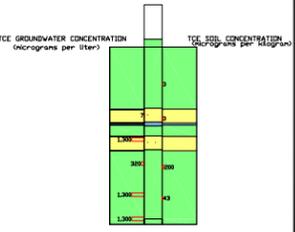
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA
FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-7
GENERALIZED CROSS SECTIONS G-G' AND H-H'
SHOWING PCE SOIL AND GROUNDWATER CONCENTRATIONS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

REVISION: 0
 AUTHOR: KLD
 FILE : PLATE9-7.DWG



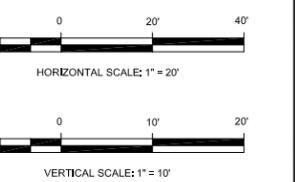


- LEGEND**
- INTERVAL NOT LOGGED
 - CL CLAY, SILTY CLAY
 - GP/GM GRAVEL WITH SAND & SILT
 - ML SILT, CLAYEY SILT, SANDY SILT
 - SM SILTY SAND
 - SP SAND
 - TCE TRICHLOROETHENE
 - [G-G'] INTERSECTING CROSS SECTION
 - TCE CONCENTRATION
 - WELL SCREEN
 - START OF W88-1 LITHOLOGY LOGGED DURING WELL INSTALLATION



NOTE: CROSS SECTIONS REPRESENT VERTICAL SLICES THROUGH 3-DIMENSIONAL SOLID MODEL GENERATED IN ROCKWORKS. LITHOLOGIES NOT ANCHORED BY CPT LOCATIONS REPRESENT LITHOLOGY PROJECTED INTO PLANE OF CROSS SECTION FROM OUTSIDE PLANE OF VIEW.

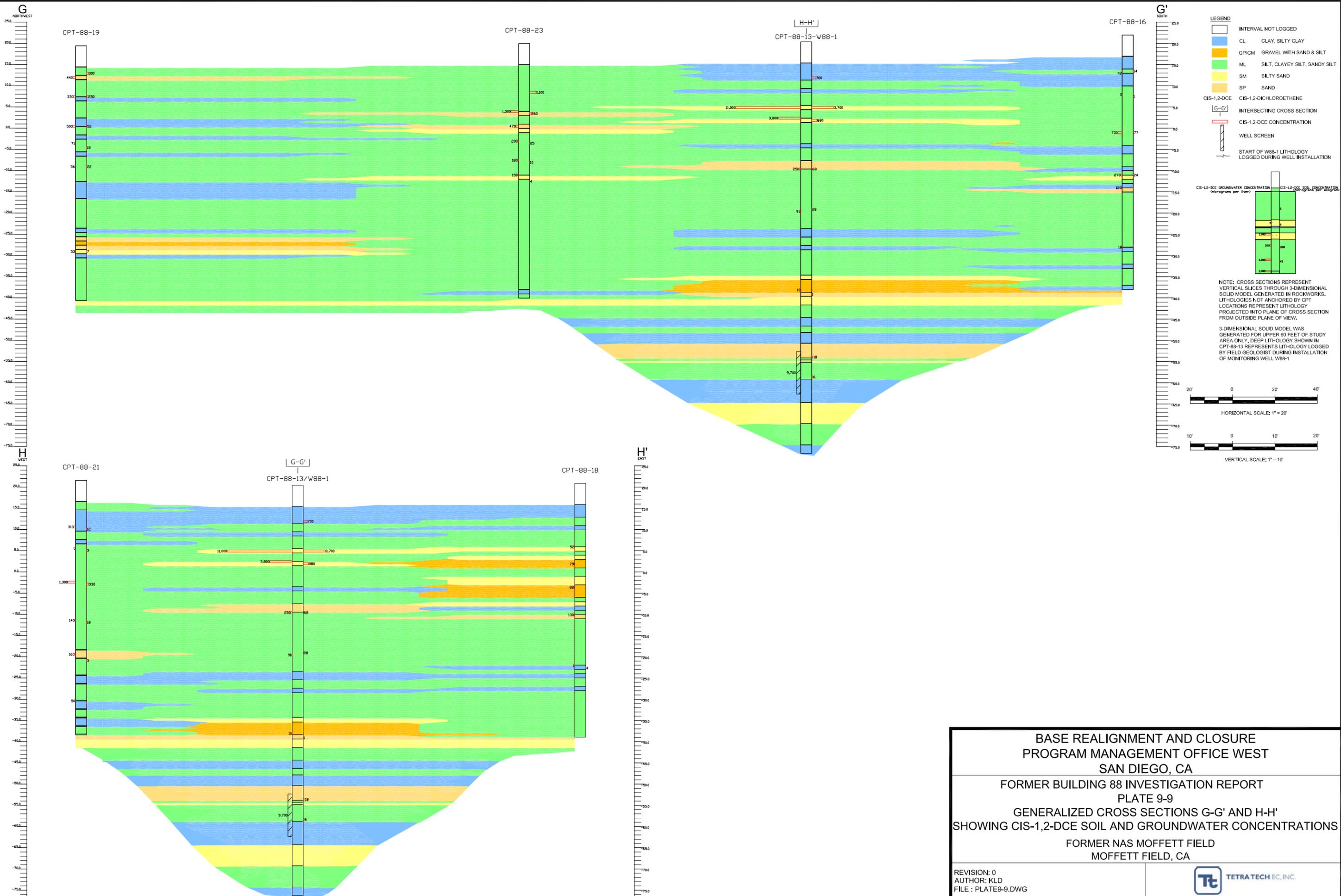
3-DIMENSIONAL SOLID MODEL WAS GENERATED FOR UPPER 60 FEET OF STUDY AREA ONLY. DEEP LITHOLOGY SHOWN IN CPT-88-13 REPRESENTS LITHOLOGY LOGGED BY FIELD GEOLOGIST DURING INSTALLATION OF MONITORING WELL W88-1



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA
FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-8
GENERALIZED CROSS SECTIONS G-G' AND H-H'
SHOWING TCE SOIL AND GROUNDWATER CONCENTRATIONS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

REVISION: 0
 AUTHOR: KLD
 FILE: PLATE9-8.DWG

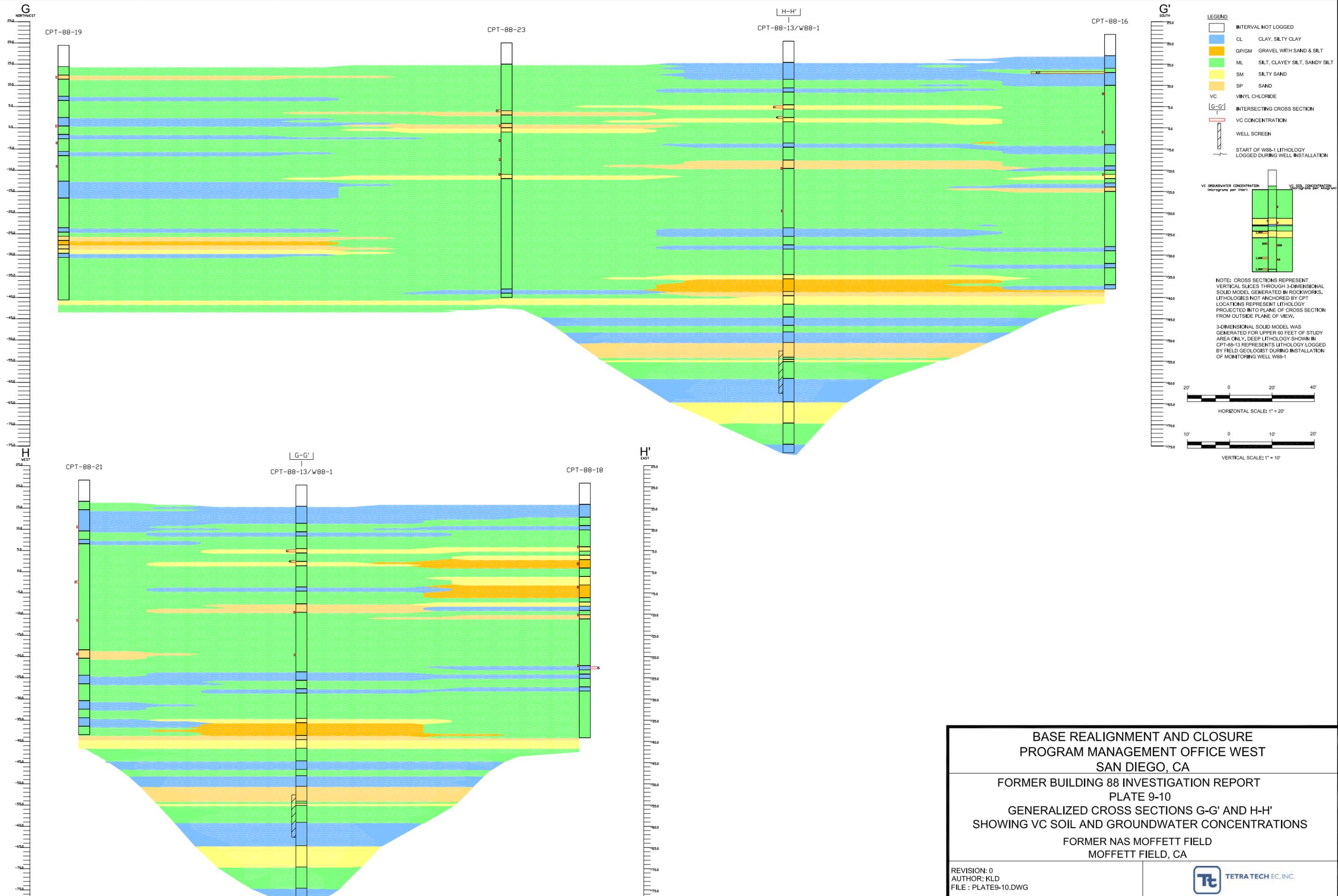




BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CA
 FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-9
 GENERALIZED CROSS SECTIONS G-G' AND H-H'
 SHOWING CIS-1,2-DCE SOIL AND GROUNDWATER CONCENTRATIONS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CA

REVISION: 0
 AUTHOR: KLD
 FILE: PLATE9-9.DWG





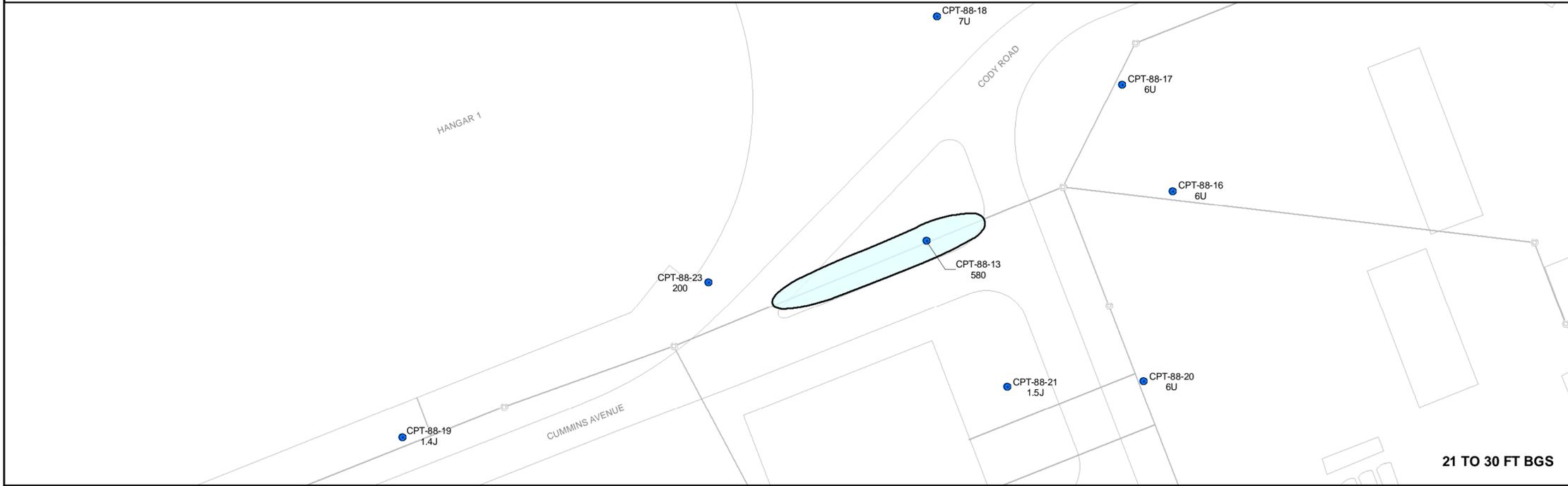
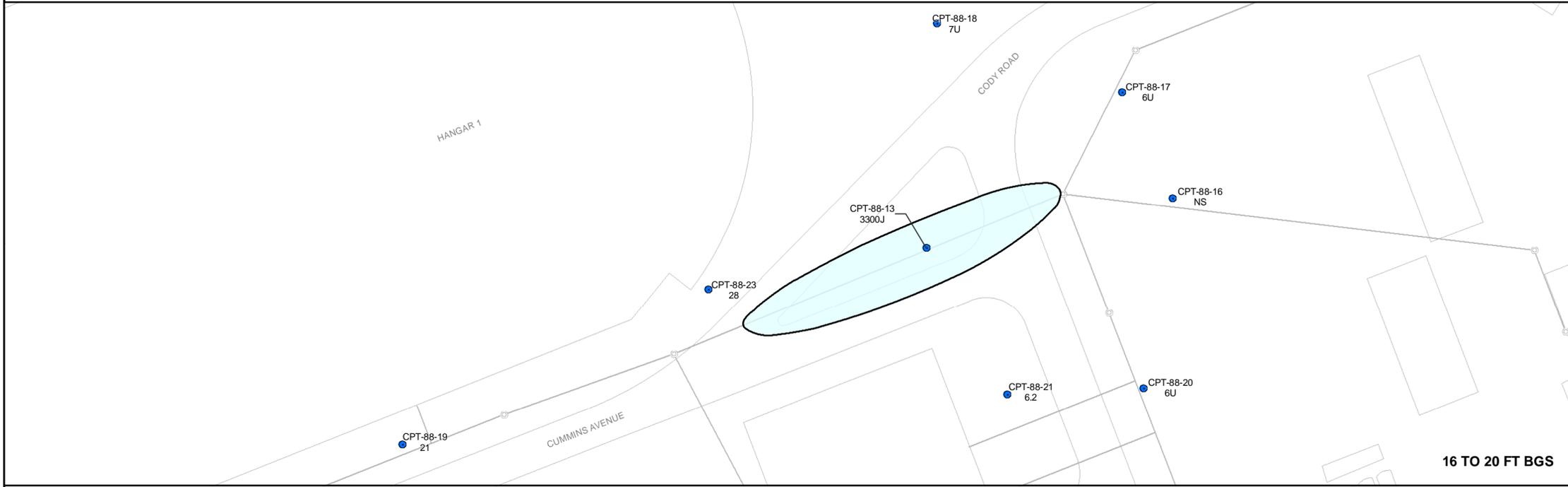
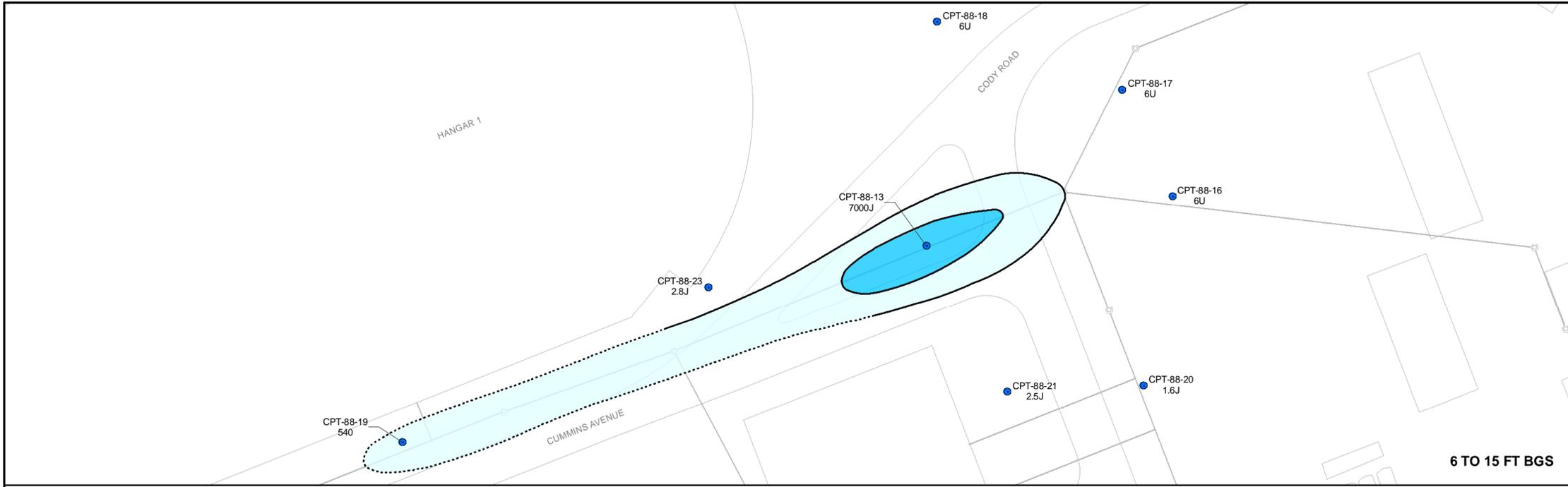
NOTE: CROSS SECTIONS REPRESENT VERTICAL SLICES THROUGH 3-DIMENSIONAL SOLID MODEL GENERATED IN ROCKWORKS. LITHOLOGIES NOT ANCHORED BY CPT LOCATIONS REPRESENT LITHOLOGY PROJECTED INTO PLANE OF CROSS SECTION FROM OUTSIDE PLANE OF VIEW.

3-DIMENSIONAL SOLID MODEL WAS GENERATED FOR UPPER 60 FEET OF STUDY AREA ONLY. DEEP LITHOLOGY SHOWN IN CPT-88-13 REPRESENTS LITHOLOGY LOGGED BY FIELD GEOLOGIST DURING INSTALLATION OF MONITORING WELL W88-1

BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CA
FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-10
GENERALIZED CROSS SECTIONS G-G' AND H-H'
SHOWING VC SOIL AND GROUNDWATER CONCENTRATIONS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CA

REVISION: 0
 AUTHOR: KLD
 FILE : PLATE9-10.DWG





LEGEND

- CPT-88-15 42J ● CPT/DPT LOCATION
- PCE CONCENTRATION µg/kg
- 480 - 5000 µg/kg PCE
DASHED WHERE INFERRED
- > 5000 µg/kg PCE

NOTES:

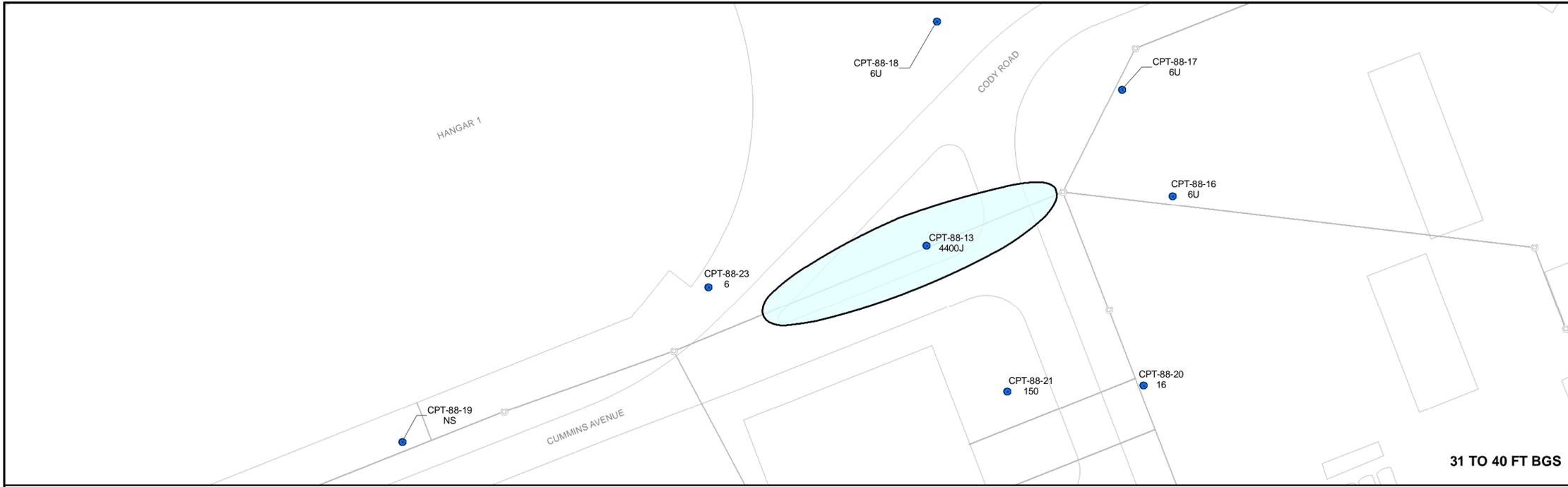
- µg/kg - MICROGRAMS PER KILOGRAM
- BGS - BELOW GROUND SURFACE
- CPT - CONE PENETROMETER TESTING
- FT - FEET
- J - ESTIMATED VALUE
- NAS - NAVAL AIR STATION
- NS - NOT SAMPLED
- PCE - TETRACHLOROETHENE
- U - NOT DETECTED AT LABORATORY REPORTING LIMIT



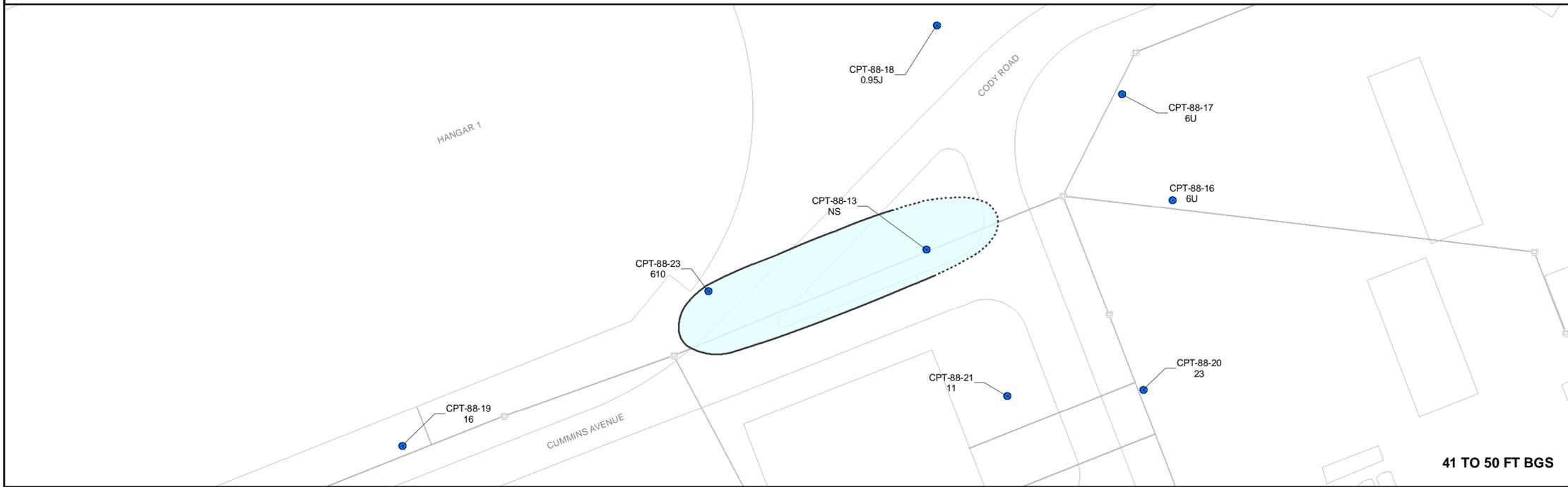
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA
FINAL FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-11
TRAFFIC ISLAND AREA SOIL PCE ISOCONCENTRATIONS
6 - 30 FEET BGS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

REVISION: 1
AUTHOR: CS
DCN: EC360-2201-0017-0003
FILE NUMBER: 0800832072.mxd

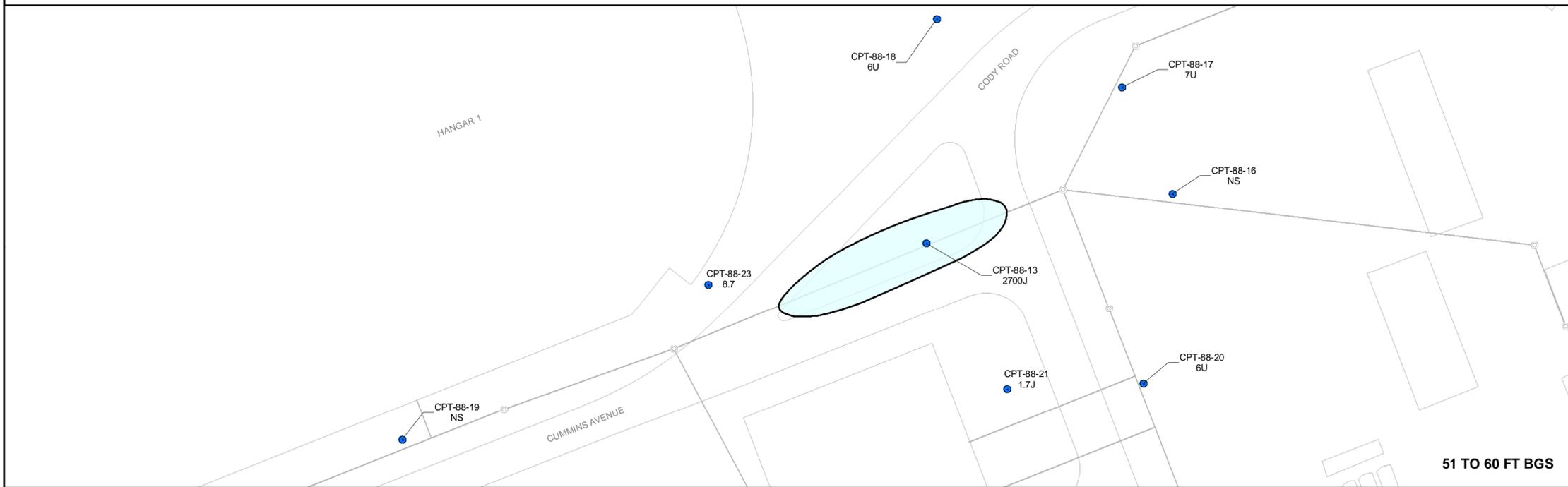




31 TO 40 FT BGS



41 TO 50 FT BGS



51 TO 60 FT BGS

LEGEND

CPT-88-15 42J ● CPT/DPT LOCATION
 PCE CONCENTRATION µg/kg

480 - 5000 µg/kg PCE
 DASHED WHERE INFERRED

NOTES:

µg/kg - MICROGRAMS PER KILOGRAM
 BGS - BELOW GROUND SURFACE
 CPT - CONE PENETROMETER TESTING
 FT - FEET
 J - ESTIMATED VALUE
 NAS - NAVAL AIR STATION
 NS - NOT SAMPLED
 PCE - TETRACHLOROETHENE
 U - NOT DETECTED AT LABORATORY REPORTING LIMIT

41 TO 50 FT BGS - PCE CONCENTRATION AT CPT-88-13
 INFERRED FROM CONCENTRATIONS
 BETWEEN 31 TO 40 FT BGS AND
 51 TO 60 FT BGS



BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CALIFORNIA

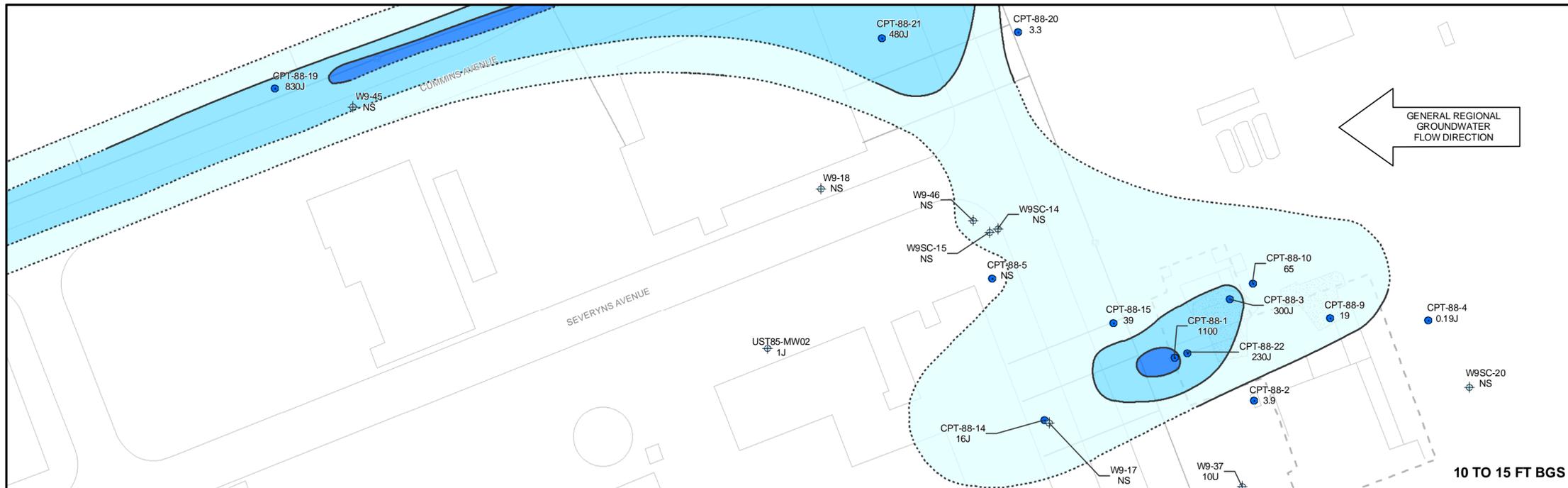
FINAL FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-12

TRAFFIC ISLAND AREA SOIL PCE
 ISOCONCENTRATIONS 31 - 60 FEET BGS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

REVISION: 1
 AUTHOR: CS
 DCN: ECSO-2201-0017-0003
 FILE NUMBER: 080083C2017.mxd

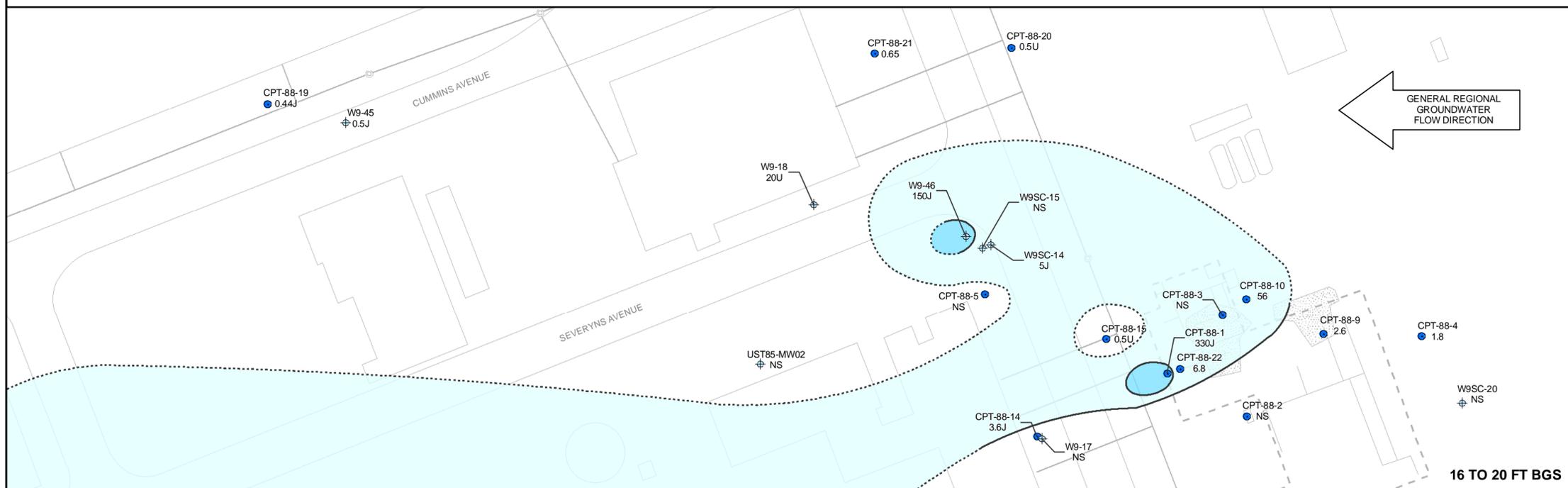


TETRA TECH, INC.

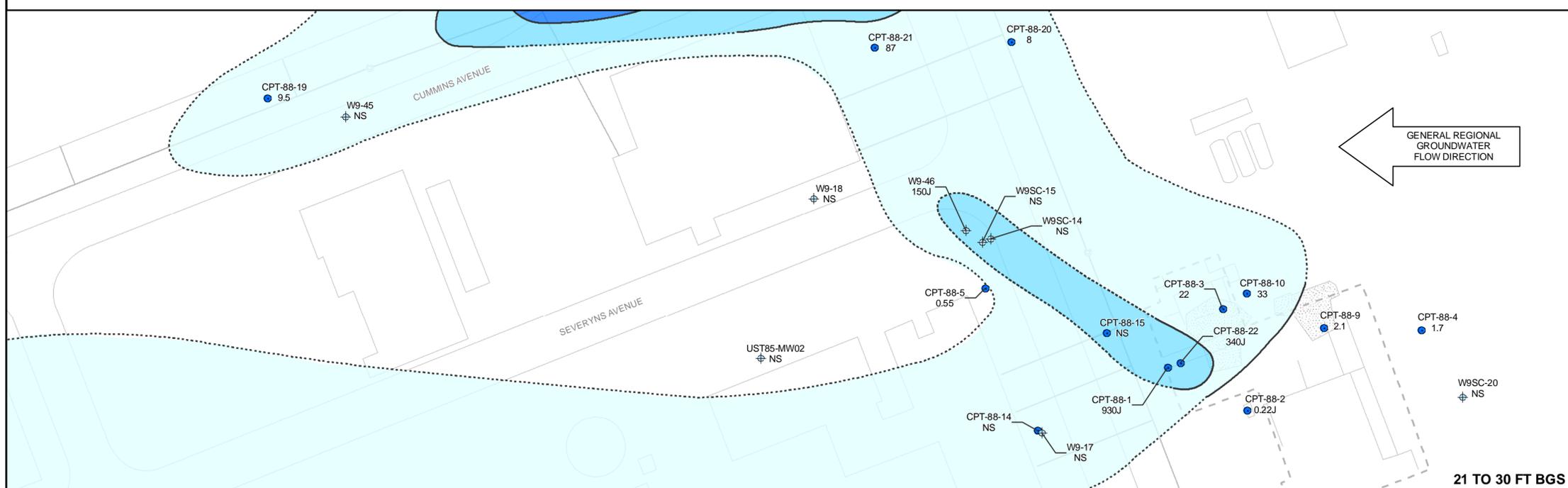


- LEGEND**
- W9-37 10U \oplus MONITORING WELL LOCATION
 - 10U \oplus PCE CONCENTRATION $\mu\text{g/L}$
 - CPT-88-15 39 \bullet CPT/DPT LOCATION
 - 39 \bullet PCE CONCENTRATION $\mu\text{g/L}$
 - 5 - 100 $\mu\text{g/L}$ PCE
 - 100 - 1000 $\mu\text{g/L}$ PCE
 - > 1000 $\mu\text{g/L}$ PCE
- NOTES:**
- $\mu\text{g/L}$ - MICROGRAMS PER LITER
 - BGS - BELOW GROUND SURFACE
 - CPT - CONE PENETROMETER TESTING
 - FT - FEET
 - J - ESTIMATED VALUE
 - NAS - NAVAL AIR STATION
 - NS - CPT - NOT SAMPLED IN INTERVAL
 - NS - WELL - NOT SCREENED IN INTERVAL
 - PCE - TETRACHLOROETHENE
 - U - NOT DETECTED AT LABORATORY REPORTING LIMIT

10 TO 15 FT BGS



16 TO 20 FT BGS



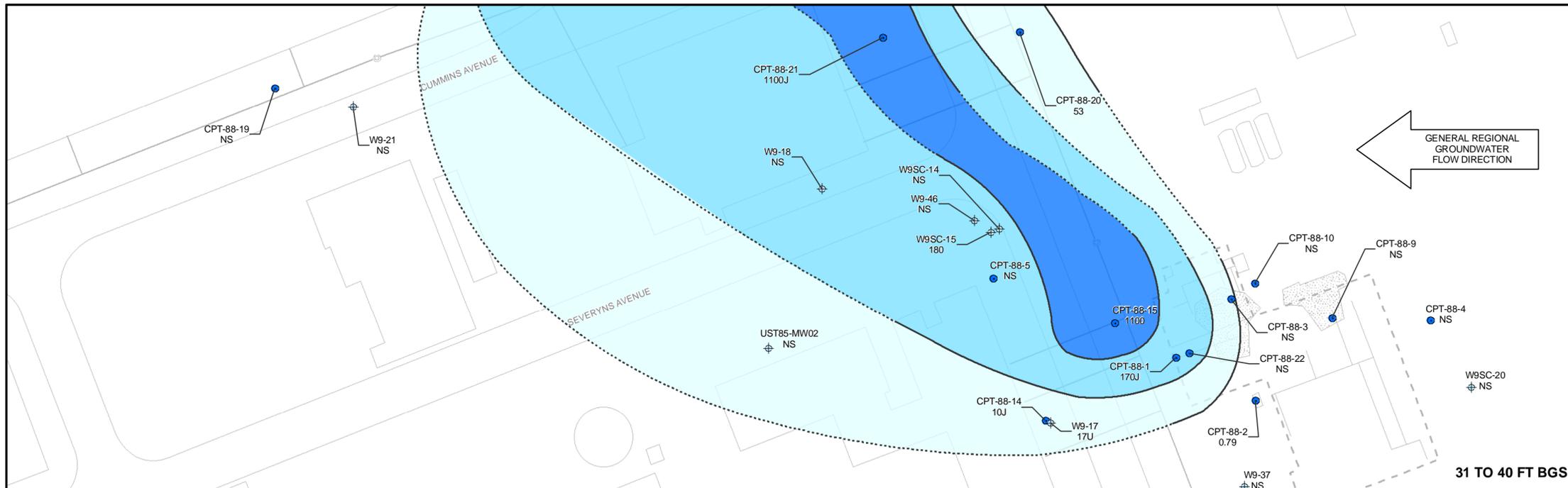
21 TO 30 FT BGS



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA
FINAL FORMER BUILDING 88 INVESTIGATION REPORT
PLATE 9-13
FORMER BUILDING 88 AREA GROUNDWATER PCE
ISOCONCENTRATIONS 10 - 30 FEET BGS
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA

REVISION: 0
AUTHOR: CS
DCN: ECSD-2201-0017-0003
FILE NUMBER: 090083C2074.mxd

Tt TETRA TECH EC, INC.



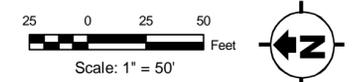
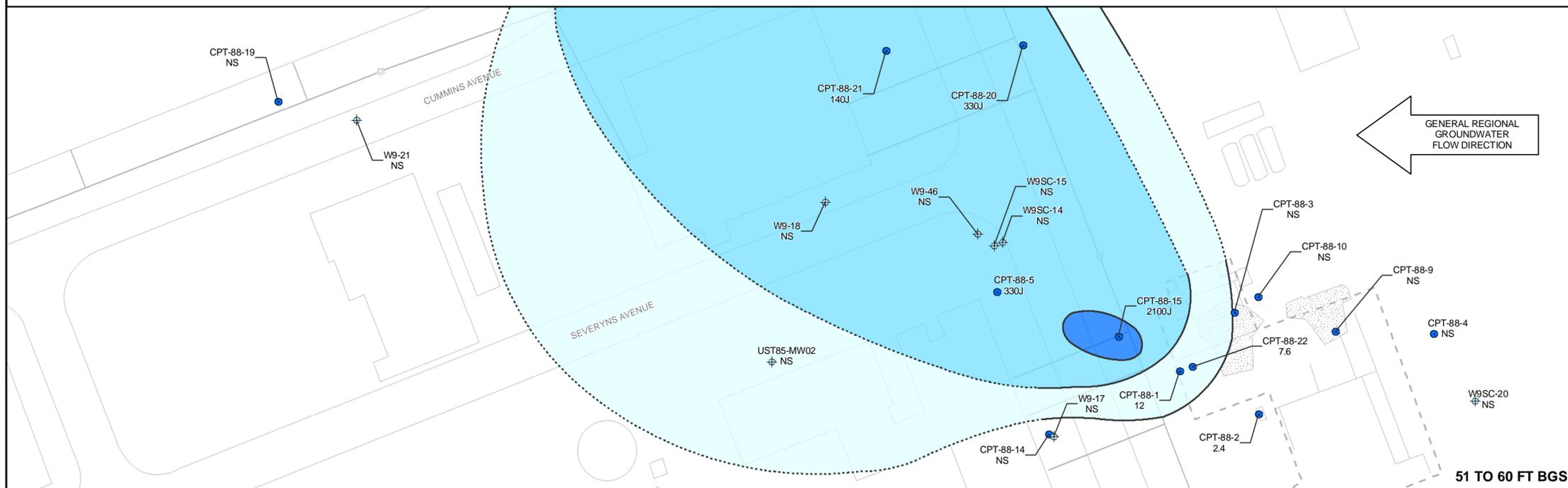
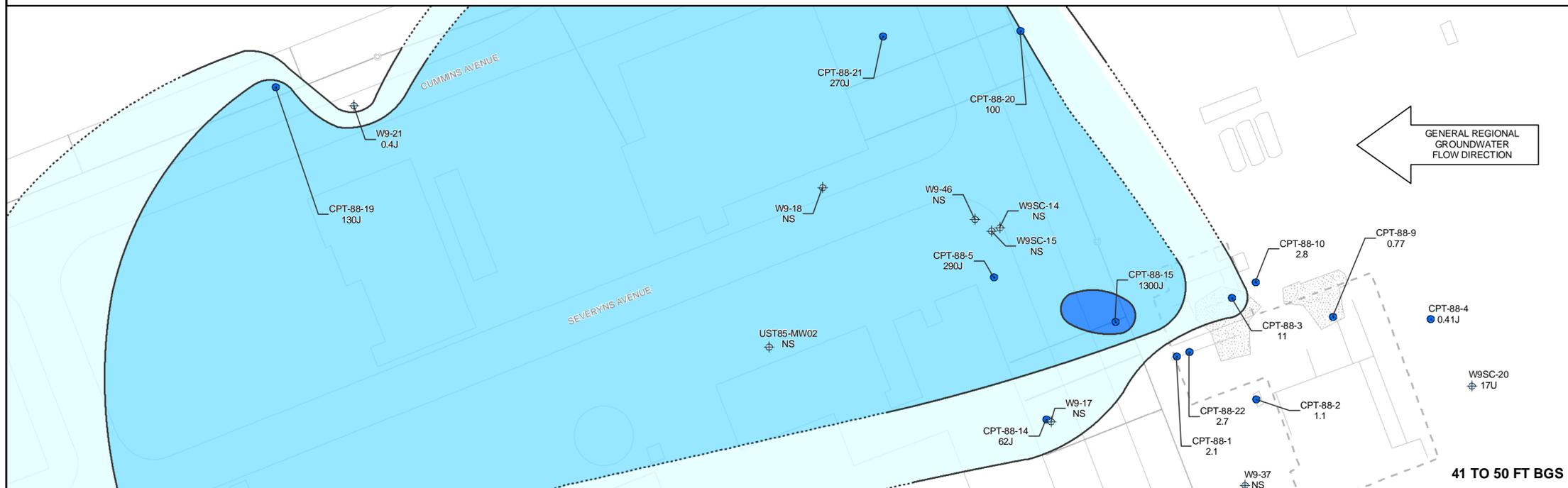
LEGEND

W9-18 17 MONITORING WELL LOCATION
 PCE CONCENTRATION µg/L

CPT-88-15 42J CPT/DPT LOCATION
 PCE CONCENTRATION µg/L

5 - 100 µg/L PCE
 100 - 1000 µg/L PCE
 1000 - 10000 µg/L PCE

NOTES:
 µg/L - MICROGRAMS PER LITER
 BGS - BELOW GROUND SURFACE
 CPT - CONE PENETROMETER TESTING
 FT - FEET
 J - ESTIMATED VALUE
 NAS - NAVAL AIR STATION
 NS - CPT - NOT SAMPLED IN INTERVAL
 NS - WELL - NOT SCREENED IN INTERVAL
 PCE - TETRACHLOROETHENE
 U - NOT DETECTED AT LABORATORY REPORTING LIMIT

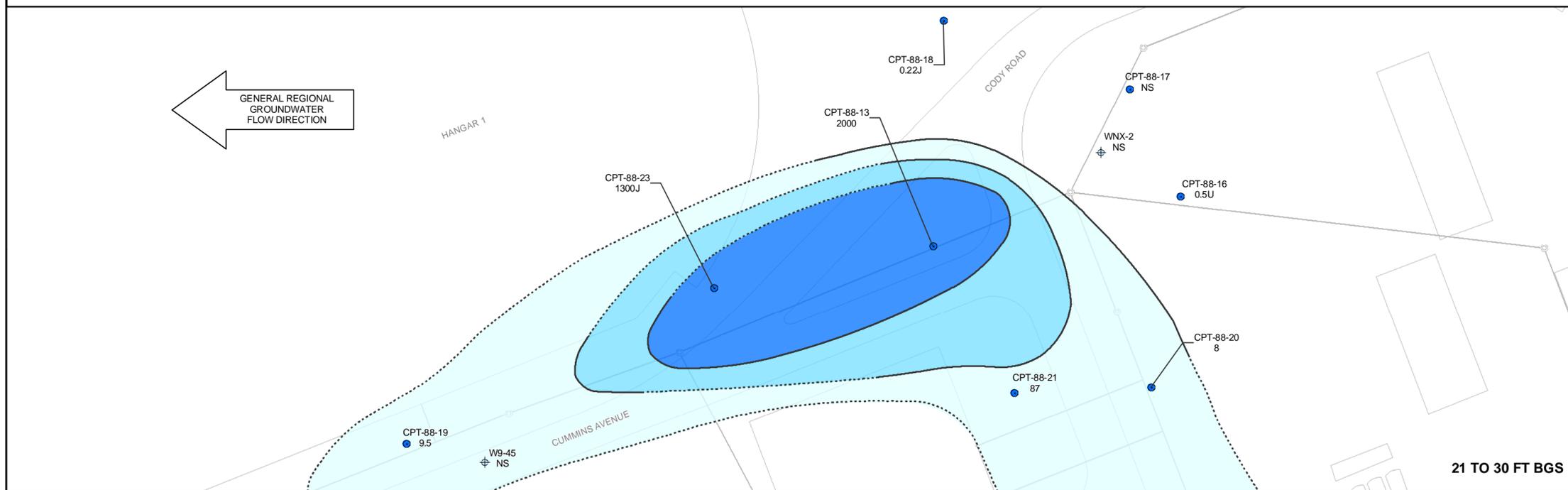
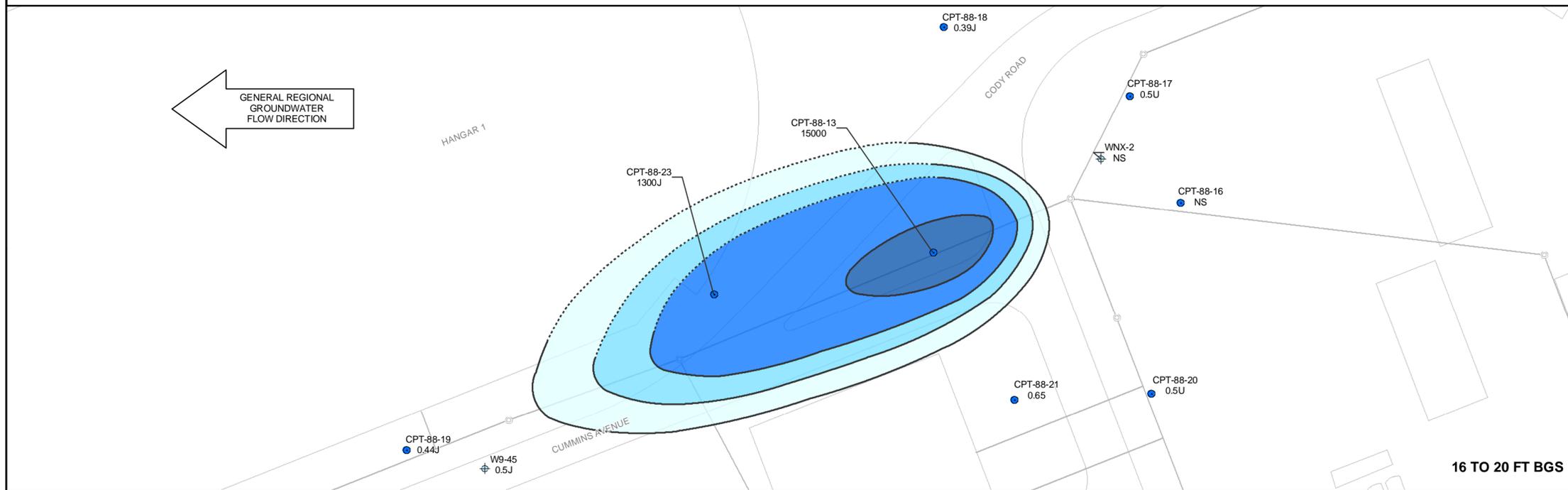
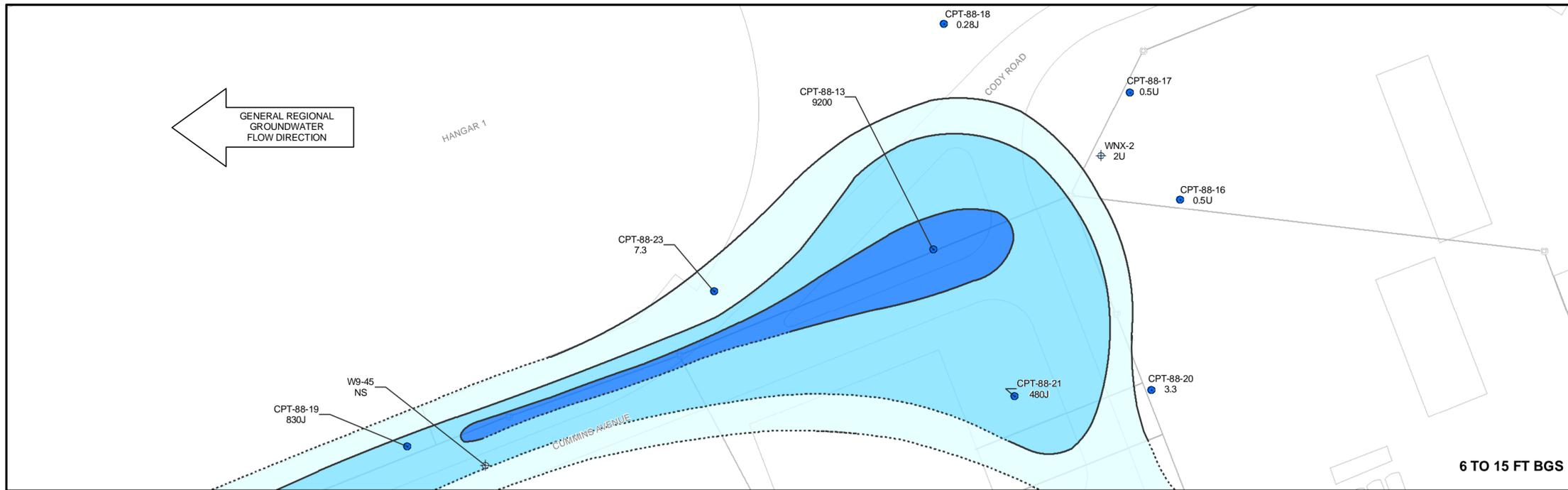


BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CALIFORNIA

FINAL FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-14
 FORMER BUILDING 88 AREA GROUNDWATER PCE
 ISOCONCENTRATIONS 31 - 60 FEET BGS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

REVISION: 0
 AUTHOR: CS
 DCN: ECS0-2201-0017-0003
 FILE NUMBER: 0800832075.mxd

TETRA TECH, INC.



LEGEND

W9-18 20U † MONITORING WELL LOCATION
 PCE CONCENTRATION µg/L

CPT-88-15 42J ● CPT/DPT LOCATION
 PCE CONCENTRATION µg/L

5 - 100 µg/L PCE
 100 - 1000 µg/L PCE
 1000 - 10000 µg/L PCE
 > 10000 µg/L PCE

NOTES:

µg/L - MICROGRAMS PER LITER
 BGS - BELOW GROUND SURFACE
 CPT - CONE PENETROMETER TESTING
 FT - FEET
 J - ESTIMATED VALUE
 NAS - NAVAL AIR STATION
 NS - CPT - NOT SAMPLED IN INTERVAL
 NS - WELL - NOT SCREENED IN INTERVAL
 PCE - TETRACHLOROETHENE
 U - NOT DETECTED AT LABORATORY REPORTING LIMIT

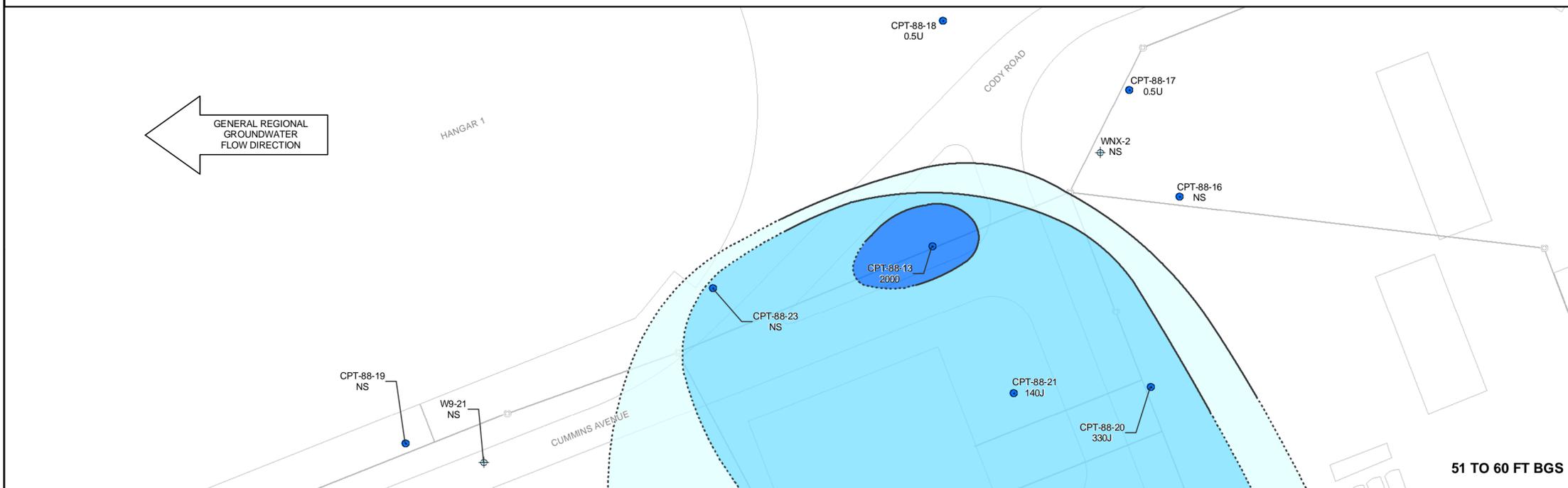
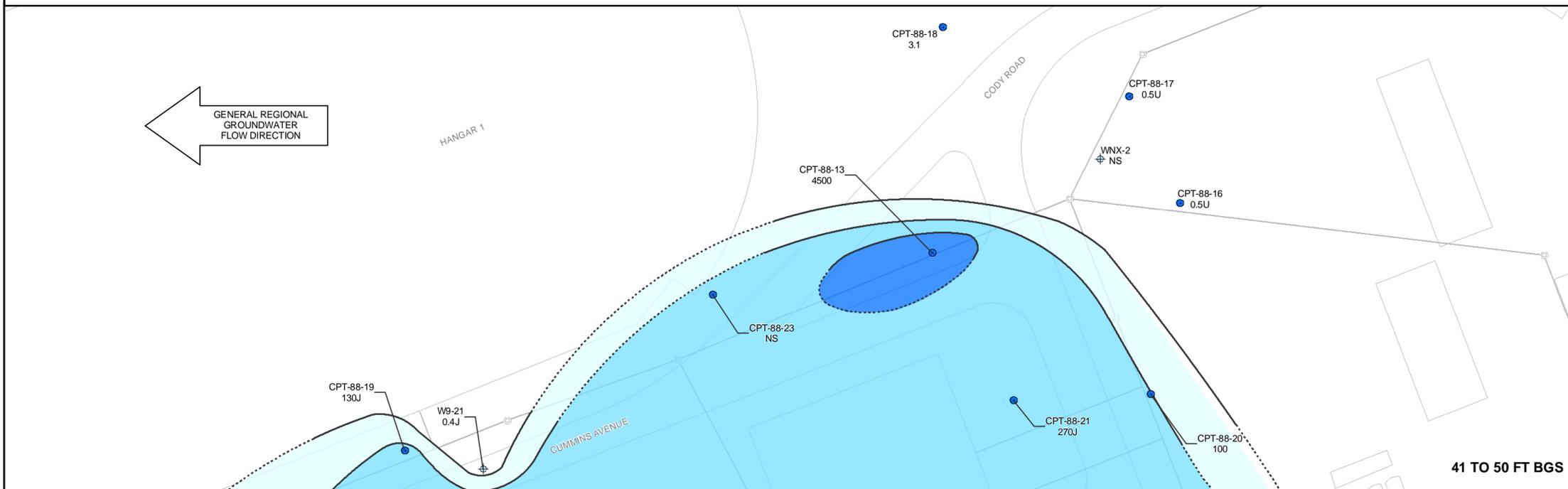
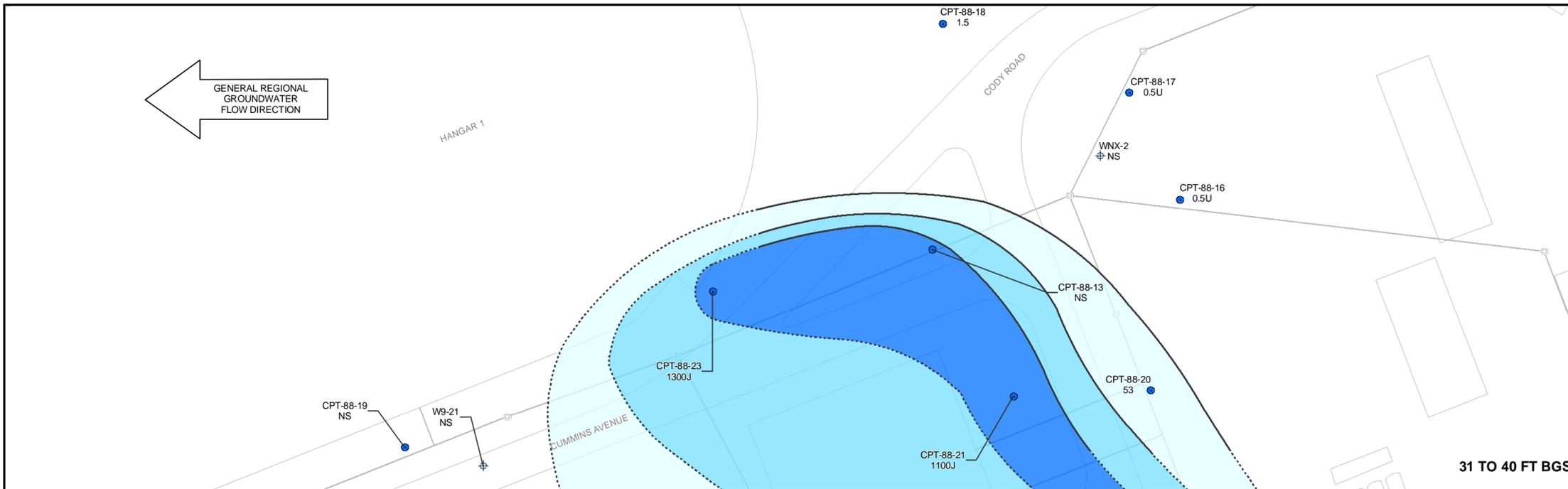
25 0 25 50 Feet
 Scale: 1" = 50'

**BASE REALIGNMENT AND CLOSURE
 PROGRAM MANAGEMENT OFFICE WEST
 SAN DIEGO, CALIFORNIA**

**FINAL FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-15
 TRAFFIC ISLAND AREA GROUNDWATER PCE
 ISOCONCENTRATIONS 6 - 30 FEET BGS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA**

REVISION: 0
 AUTHOR: CS
 DCN: ECSD-2201-0017-0003
 FILE NUMBER: 080083C2076.mxd

Tetra Tech EC, Inc.



BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
SAN DIEGO, CALIFORNIA
 FINAL FORMER BUILDING 88 INVESTIGATION REPORT
 PLATE 9-16
 TRAFFIC ISLAND AREA GROUNDWATER PCE
 ISOCONCENTRATIONS 31 - 60 FEET BGS
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

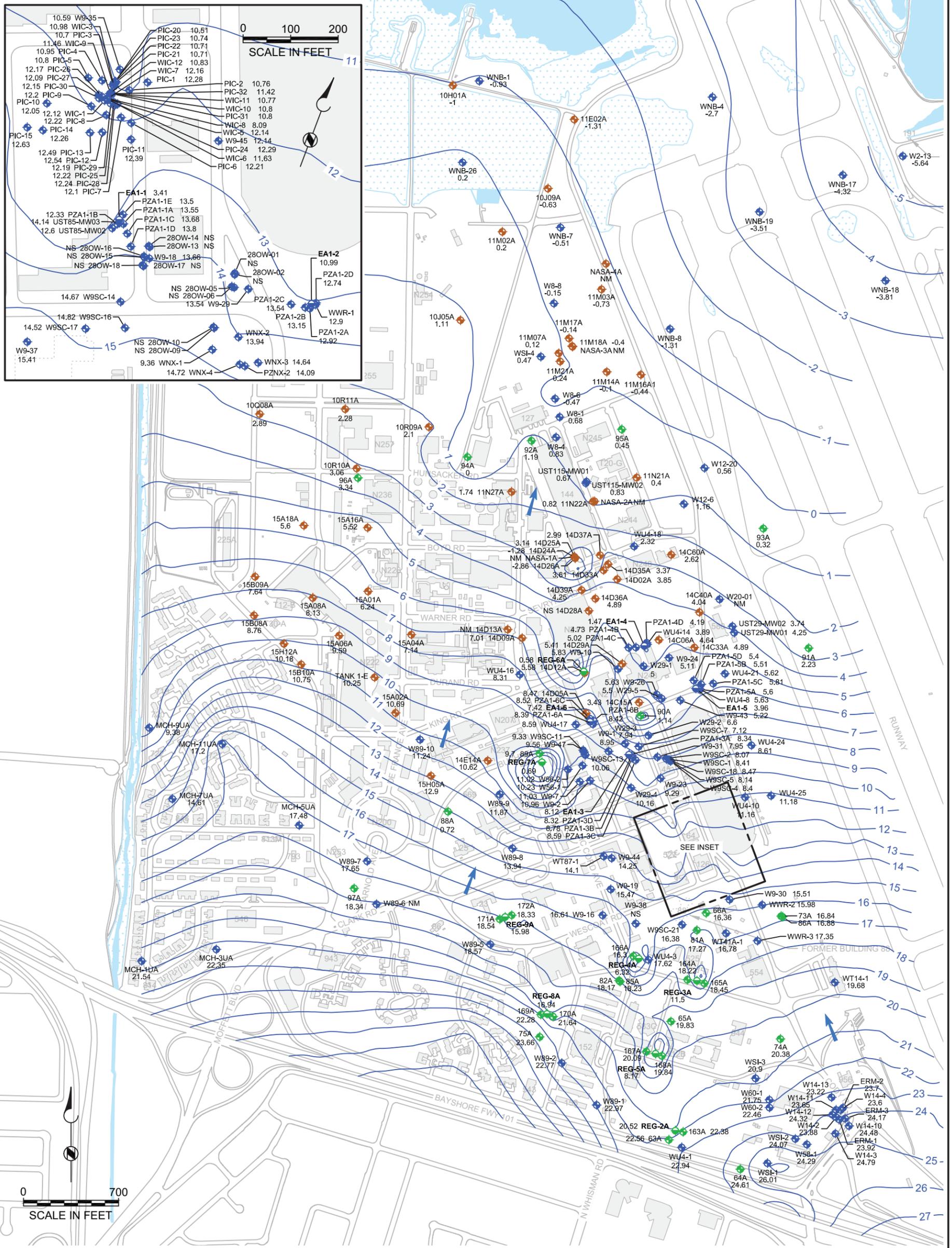
REVISION: 0
 AUTHOR: CS
 DON: ECSD-2201-0017-0003
 FILE NUMBER: 080083C2077.mxd

TETRA TECH EC, INC.

Scale: 1" = 50'

25 0 25 50 Feet

Scale: 1" = 50'

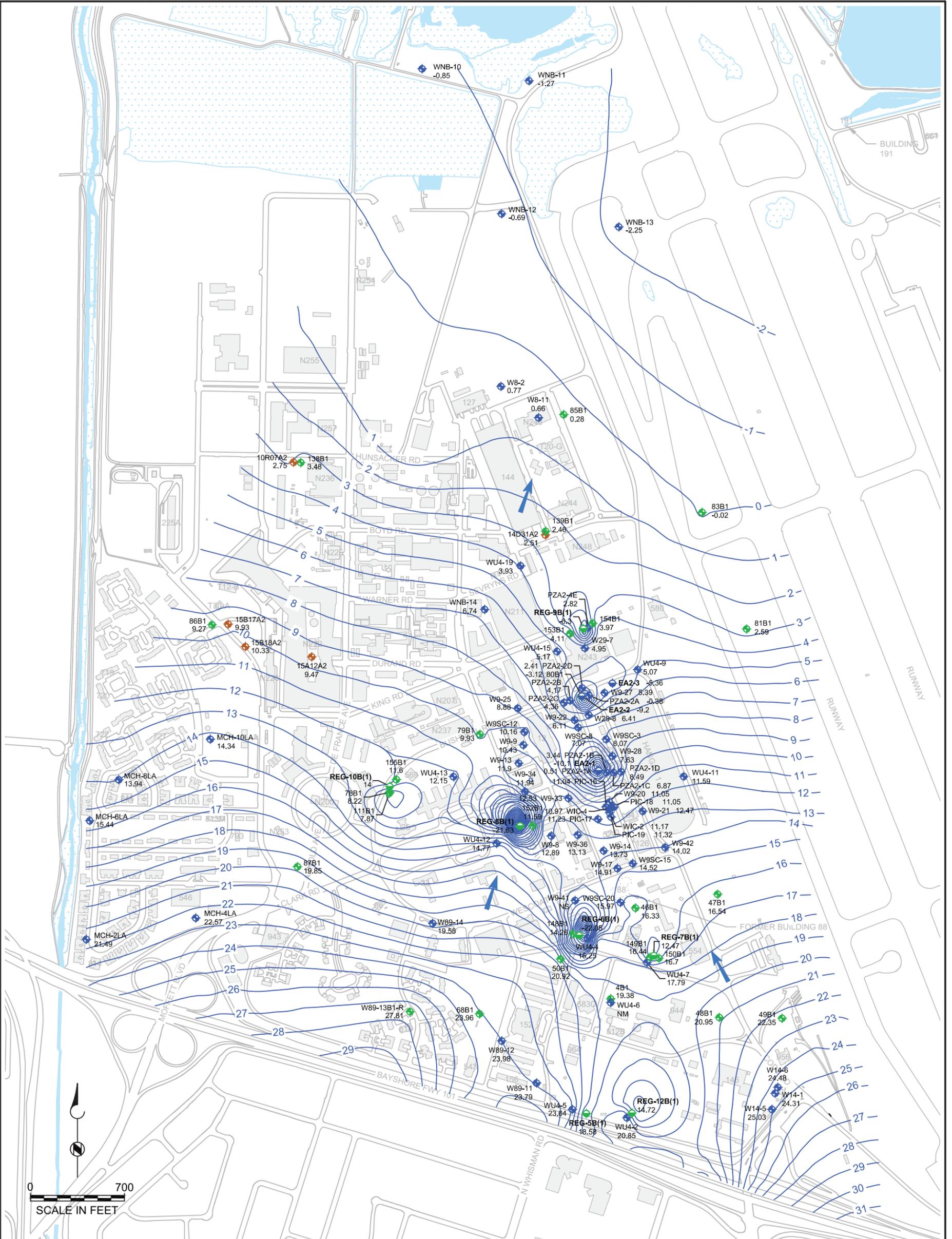


EXPLANATION

- | | | | |
|-----------------|---|--------|----------------------------|
| EA1-2
11.48 | NAVY EXTRACTION WELL
WATER ELEVATION IN FEET (MSL)
ADJUSTED FOR WELL LOSS | — 26 — | GROUNDWATER CONTOUR |
| REG-8A
16.94 | MEW EXTRACTION WELL
WATER ELEVATION IN FEET (MSL) | ← | GROUNDWATER FLOW DIRECTION |
| W89-10
11.24 | NAVY MONITORING WELL
WATER ELEVATION IN FEET (MSL) | — | ROAD |
| 15H05A
12.9 | NASA MONITORING WELL
WATER ELEVATION IN FEET (MSL) | ⊖ | WETLAND |
| 89A
9.7 | MEW MONITORING WELL
WATER ELEVATION IN FEET (MSL) | | |
- NOTE:**
- GROUNDWATER LEVELS MEASURED ON MARCH 25, 2010.
 - GROUNDWATER ELEVATIONS FOR NON-NAVY WELLS PROVIDED BY RGRP GROUP, FEB 2011

2010 ANNUAL GROUNDWATER REPORT FOR IR SITES 26 AND 28
 Figure 2-53
POTENTIOMETRIC SURFACE MAP, IR SITE 28, UPPER PORTION OF THE A AQUIFER
 MARCH 25, 2010
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA

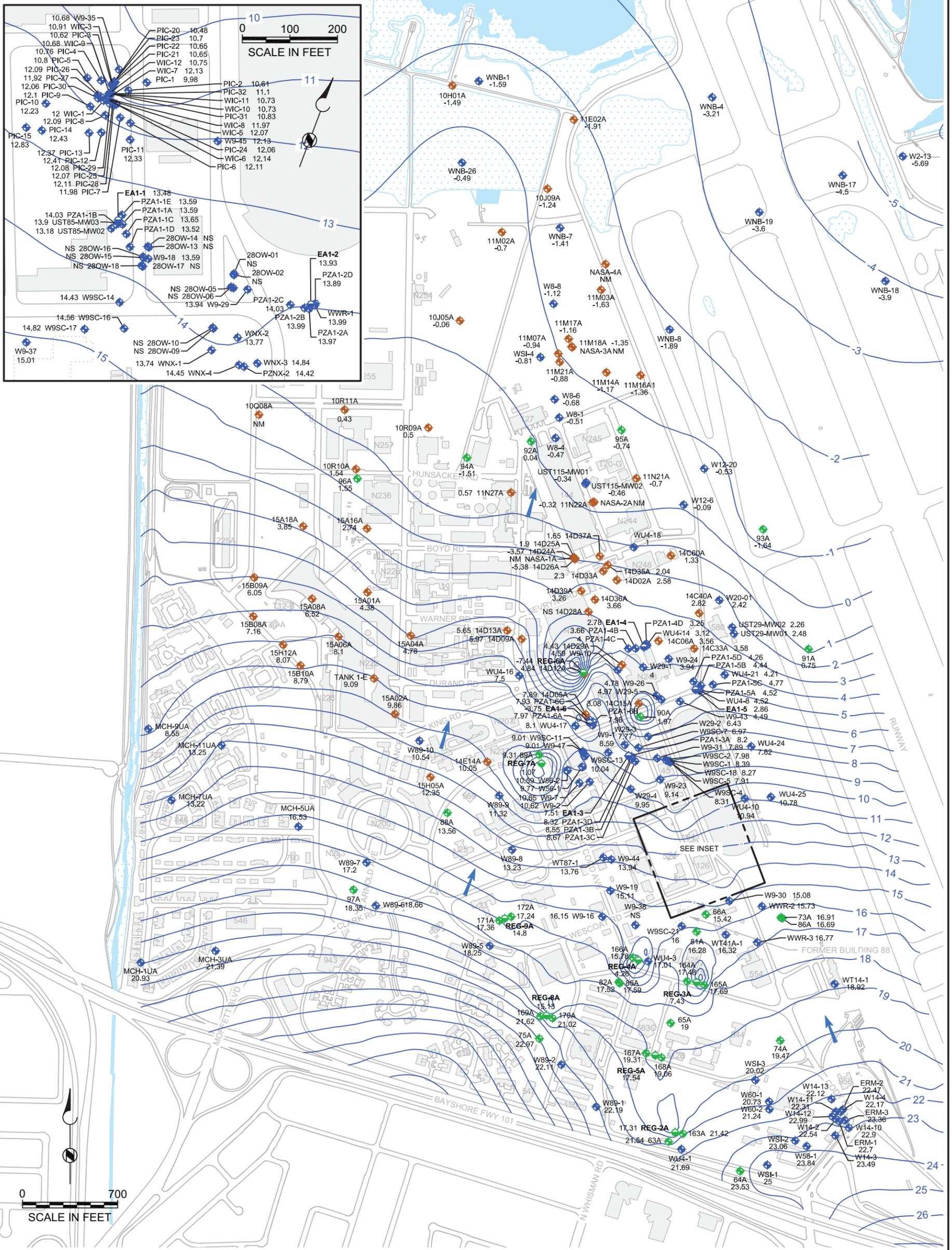




EXPLANATION

- | | | | |
|-----------------|---|--------|----------------------------|
| EA1-2
13.93 | NAVY EXTRACTION WELL
WATER ELEVATION IN FEET (MSL)
ADJUSTED FOR WELL LOSS | — 26 — | GROUNDWATER CONTOUR |
| REG-8A
15.13 | MEW EXTRACTION WELL
WATER ELEVATION IN FEET (MSL) | ← | GROUNDWATER FLOW DIRECTION |
| W89-10
10.54 | NAVY MONITORING WELL
WATER ELEVATION IN FEET (MSL) | — | ROAD |
| 15H05A
12.35 | NASA MONITORING WELL
WATER ELEVATION IN FEET (MSL) | ⊖ | WETLAND |
| 89A
9.31 | MEW MONITORING WELL
WATER ELEVATION IN FEET (MSL) | | |
- NOTE:**
- GROUNDWATER LEVELS MEASURED ON MARCH 25, 2010.
 - GROUNDWATER ELEVATIONS FOR NON-NAVY WELLS PROVIDED BY RGRP GROUP, FEB 2011

2010 ANNUAL GROUNDWATER
REPORT FOR IR SITES 26 AND 28
Figure 2-54
**POTENTIOMETRIC
SURFACE MAP, IR SITE 28,
LOWER PORTION OF THE
A AQUIFER**
MARCH 25, 2010
FORMER NAS MOFFETT FIELD
MOFFETT FIELD, CALIFORNIA



EXPLANATION

- | | | | |
|-----------------|---|--------|----------------------------|
| EA1-2
11.48 | NAVY EXTRACTION WELL
WATER ELEVATION IN FEET (MSL)
ADJUSTED FOR WELL LOSS | — 26 — | GROUNDWATER CONTOUR |
| REG-8A
16.94 | MEW EXTRACTION WELL
WATER ELEVATION IN FEET (MSL) | ← | GROUNDWATER FLOW DIRECTION |
| W89-10
11.24 | NAVY MONITORING WELL
WATER ELEVATION IN FEET (MSL) | — | ROAD |
| 15H05A
12.9 | NASA MONITORING WELL
WATER ELEVATION IN FEET (MSL) | ⊖ | WETLAND |
| 89A
9.7 | MEW MONITORING WELL
WATER ELEVATION IN FEET (MSL) | | |
- NOTE:
 • GROUNDWATER LEVELS MEASURED ON NOVEMBER 18, 2010.
 • GROUNDWATER ELEVATIONS FOR NON-NAVY WELLS PROVIDED BY RGRP GROUP, FEB 2011

2010 ANNUAL GROUNDWATER REPORT FOR IR SITES 26 AND 28
 Figure 2-55
POTENTIOMETRIC SURFACE MAP, IR SITE 28, UPPER PORTION OF THE A AQUIFER
 NOVEMBER 18, 2010
 FORMER NAS MOFFETT FIELD
 MOFFETT FIELD, CALIFORNIA



Appendix E
MIP Logs from 2010 – 2011 Treatability Study
(provided on electronic copy only)